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Research Report 1491

The Development and Implementation of Basic, Advanced, and Unit M16A1 Rifle Marksmanship Training Programs

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August 1988

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS ---	
2a. SECURITY CLASSIFICATION AUTHORITY ---		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE ---			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ARI Research Report 1491		5. MONITORING ORGANIZATION REPORT NUMBER(S) ---	
6a. NAME OF PERFORMING ORGANIZATION Litton Computer Services	6b. OFFICE SYMBOL (If applicable) ---	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences	
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 2498 Fort Benning, GA 31905		7b. ADDRESS (City, State, and ZIP Code) P.O. Box 2086 Fort Benning, GA 31905-0686	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences	8b. OFFICE SYMBOL (If applicable) PERI-I	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA903-80-C-0345	
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. 63743	PROJECT NO. A794
		TASK NO. 3.2.2	WORK UNIT ACCESSION NO. C1
11. TITLE (Include Security Classification) The Development and Implementation of Basic, Advanced, and Unit M16A1 Rifle Marksmanship Training Programs			
12. PERSONAL AUTHOR(S) K. L. Evans and A. D. Osborne			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM 1976 to 1983	14. DATE OF REPORT (Year, Month, Day) 1988, August	15. PAGE COUNT 76
16. SUPPLEMENTARY NOTATION Seward Smith, Contracting Officer's Representative			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) M16A1 rifle Advanced rifle marksmanship Rifle marksmanship training Unit rifle marksmanship Basic rifle marksmanship (continued)	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report summarizes the research on M16A1 rifle marksmanship training conducted by the Army Research Institute (ARI) at Fort Benning primarily between March 1978 and January 1983. It examines research designed to identify marksmanship training problems and to evaluate promising solutions to these problems.			
The overall marksmanship research led to the development and implementation of an integrated set of three training programs: basic, advanced, and unit rifle marksmanship. These programs have been approved for adoption Army-wide by the U.S. Army Infantry School (USAIS) (as proponent). Implementation efforts are documented in the areas of equipment research, target design, range modification, training aids and devices, and instructor training.			
(continued)			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Seward Smith		22b. TELEPHONE (Include Area Code) (404) 545-5589	22c. OFFICE SYMBOL ---

ARI Research Report 1491

19. Key Words (Continued)

Marksmanship ranges
 Marksmanship targets
 Marksmanship training devices
 M16A2 rifle
 Training Effectiveness Analysis

Zeroing
 Down-range feedback
 New marksmanship program
 Marksmanship instructor training

20. Abstract (Continued)

The report also summarizes the major problems that must be resolved for fully effective marksmanship training. It concludes with information about current or planned research directed toward improved marksmanship instruction.

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NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/ _____	
Availability Codes	
Avail and/or	
Dist	Special
A-1	



Keywords: Army

Training, Infantry, Gunney
 training, training devices,
 training effectiveness (SIN)

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August 1988

Army Project Number
2Q263743A794

Education and Training

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FOREWORD

The Fort Benning Field Unit of the U.S. Army Research Institute (ARI) and its resident contractor, Litton Computer Services, have conducted an ongoing program of research since 1976 designed to improve the effectiveness of M16A1 rifle marksmanship training at basic, advanced, and unit levels. Because most of this research has been documented in a series of separate publications, this report was developed to provide an integrated summary of the various efforts included in the overall research program.

Further, this research report documents the process by which revised marksmanship training programs were implemented at basic, advanced, and unit levels throughout the U.S. Army. Previously undocumented implementation efforts are presented in five areas: equipment research, target design, range modification, training aids and devices, and instructor training. Constraints encountered in the process of program implementation are addressed, as are areas of future study designed to partially overcome the effects of those constraints. Although this report was written primarily for a training research and development audience, it is also recommended for those desiring a broad, historical perspective of current rifle marksmanship training procedures in the U.S. Army.

The Army marksmanship programs described in the report are products of the Army Research Institute's Fort Benning Field Unit, which conducts research on training and training technology with particular emphasis on individual and small team skills in the Infantry arena. The research task that supports this mission is titled "Individual Training for Soldier Skills" and is organized under the "Training for Combat Effectiveness" program area. As proponent for rifle marksmanship training, the U.S. Army Infantry School provided sponsorship for the marksmanship research program. The results of this research have been briefed to the senior leadership of the U.S. Army Forces Command (FORSCOM), the U.S. Army Training and Doctrine Command (TRADOC), and the U.S. Army Infantry School (USAIS), which has subsequently implemented most of the products generated by this research program. Specifically, the program for basic rifle marksmanship training was implemented at all Army Training Centers, the program for advanced rifle marksmanship training was implemented at the U.S. Army Infantry Training Center, and the program for unit rifle marksmanship training was included in Change 3 to Field Manual 23-9, M16A1 Rifle and Rifle Marksmanship. Likewise, the series of targets developed to accompany these training programs was adopted and these targets are now available through normal supply channels.



EDGAR M. JOHNSON
Technical Director

THE DEVELOPMENT AND IMPLEMENTATION OF BASIC, ADVANCED, AND UNIT M16A1 RIFLE
MARKSMANSHIP TRAINING PROGRAMS

EXECUTIVE SUMMARY

Requirement:

In 1976 the U.S. Army began research intended to improve the training of M16A1 rifle marksmanship for entry level soldiers. In 1980 the U.S. Army initiated similar efforts intended to upgrade both advanced individual marksmanship training and unit marksmanship training. A wide variety of experiments and field evaluations have been conducted by the U.S. Army Research Institute (ARI), Fort Benning Field Unit since 1976. This report summarizes the various ARI concepts and products that have characterized the overall research program to date to provide a clearer understanding of the interrelationships between training programs at the basic, advanced, and unit levels. The report also brings attention to critical problem areas of implementation, some of which remain unresolved. Finally, the report outlines the work that must be done to develop a fully effective and integrated set of rifle marksmanship training programs.

Procedure:

The research and development efforts reported and/or summarized here consisted of three major field training experiments, a large-scale field test of M16A1 rifle characteristics and capabilities, and a variety of field observations, informal evaluations, and interviews conducted at Army Training Centers, the U.S. Marine Corps, and at several U.S. Army Forces Command (FORSCOM) unit installations. The research was designed to determine the problems that exist in U.S. Army rifle marksmanship training, to pilot test promising ideas for improvement, and to field test the impact of the potential improvements.

Findings:

Basic, advanced, and unit rifle marksmanship instructional programs were developed, refined, and tested by over 18,000 soldiers at various levels of training. As part of the program implementation process, a variety of targets and training materials were designed and/or evaluated. Instructor training procedures and materials were also developed. Further, constraints to the implementation process were identified, together with areas of future research that have the potential to partially overcome the effects of these constraints.

Utilization of findings:

The integrated set of rifle marksmanship training programs reported herein has been approved for adoption Army-wide by the U.S. Army Infantry School (USAIS) (as proponent). Minor refinements to the process of implementation are being addressed.

THE DEVELOPMENT AND IMPLEMENTATION OF BASIC, ADVANCED, AND UNIT M16A1 RIFLE
MARKSMANSHIP TRAINING PROGRAMS

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THE DEVELOPMENT AND IMPLEMENTATION OF BASIC,
ADVANCED, AND UNIT M16A1 RIFLE MARKSMANSHIP TRAINING PROGRAMS

INTRODUCTION

In 1977 the U.S. Army Research Institute (ARI) Field Unit at Fort Benning and its resident contractor, Litton Mellonics, initiated a systematic research program devoted to M16A1 rifle marksmanship training. Based upon a growing concern that existing Basic Rifle Marksmanship (BRM) training was not producing qualified marksmen for U.S. Army units, marksmanship training was examined at basic, advanced, and unit levels. The primary goal of this research program was to develop and validate an integrated set of more effective marksmanship training programs geared to combat marksmanship requirements. Conducted under the joint sponsorship of the Directorate of Training Developments of the U.S. Army Infantry School (USAIS) and the U.S. Army Forces Command (FORSCOM), this research directly responded to various Human Research Needs (HRNs) that had been identified.

Rifle marksmanship training in the U.S. Army is conducted in three separate, though conceptually related, Programs of Instruction (POIs): BRM, Advanced Rifle Marksmanship (ARM), and Unit Rifle Marksmanship. BRM training focuses on teaching those common rifle marksmanship skills needed by every soldier in the U.S. Army. All initial entry soldiers receive BRM training, which is provided at each Army Training Center (ATC). A minimum performance standard, measured on a prescribed rifle qualification course of fire, must be met by all BRM trainees. In contrast, ARM focuses on teaching more advanced marksmanship skills, in addition to BRM skills, needed by soldiers having the 11B (Light Weapons Infantryman) Military Occupational Specialty (MOS). ARM training is conducted only at Fort Benning, Georgia, as part of the Advanced Individual Training (AIT) portion of the Infantry One-Station Unit Training (OSUT) POI. Unit rifle marksmanship training is conducted by all U.S. Army units worldwide. Its purpose is twofold. First, unit training attempts to maintain soldier proficiency in the marksmanship skills acquired in BRM and ARM. Each soldier must annually meet a minimum performance standard on a rifle qualification course of fire. Second, each unit must provide training to develop other marksmanship skills that may be required as a function of their particular unit mission.

Due to the large number of pilot studies and field experiments which have been conducted in the marksmanship research program, each documented in a

¹The research has been performed in response to the following HRNs: 77-184 and 78-104, Training Effectiveness Analysis for Infantry Systems (USAIS); 79-216, Improvement of Rifle Marksmanship (FORSCOM); 80-60, Infantry Systems Training Effectiveness Development (USAIS); 80-110, Develop Plan for Assessing Weaponer Training Effectiveness in TOE Units (USAIS); 80-111, Research Directed at the Development of Methodology for Evaluating Retention of Skills in Gunner Assessments (USAIS); and 80-115, Research on Target Engagement Training for Individual and Crew Weapon Systems (USAIS).

separate publication, the present report summarizes and integrates the findings of the entire project to date. Greater emphasis is given to research carried out since 1980.² In addition, a major purpose of the present report is to document the process by which the findings of applied research were transferred into fully operational rifle marksmanship training programs. This implementation process was a complex and comprehensive one, involving target design, range modification, the design and evaluation of training devices, and the development of a series of instructor training programs. Due to constraints imposed in program implementation, the revised marksmanship training programs are not without some, as yet unresolved, shortcomings. For this reason, implementation constraints and areas of potential improvement and study are also addressed in this report.

Basic Rifle Marksmanship

Initial efforts focused on the nature of the combat threat, the required rifle marksmanship tasks to be performed, how performance on these tasks could be measured, and a determination of whether or not existing training prepared soldiers to meet the threat. Several reports were prepared which dealt with the definition of the rifle defeatable threat (Klein & Tierney, 1978), previous marksmanship research (Smillie & Chitwood, 1980), and current training procedures and possible alternatives (Maxey & George, 1977; Maxey & Sweezy, 1977). These reports indicated that the rifle defeatable threat encompassed briefly exposed personnel targets, both stationary and moving, within a range of 300 meters. It was also clearly apparent that existing BRM training was not adequately preparing soldiers to meet this threat.

Through participation in and observation of the BRM programs at four ATCs, major problems in four areas of training were identified. Presented in detail in earlier reports (Maxey & Dempster, 1978; Smith, Osborne, Thompson & Morey, 1980), these weaknesses are summarized in Table 1.

A series of field experiments was then conducted to determine the effects of potential solutions to some of these training problems. Using airborne soldiers from a FORSCOM unit preparing for their annual rifle requalification in September of 1978, three different training programs were compared. In terms of the average number of hits obtained during a record fire scenario, it was found that a training program providing greater performance feedback and increased instructor quality and quantity was associated with a significantly higher ($p < .001$) level of measured performance (Evans, Thompson & Smith, 1980). This training program was subsequently published by the U.S. Army Marksmanship Unit as a recommended interim unit marksmanship POI for FORSCOM (U.S. Army Forces Command, 1979).

Two of the major problems identified in BRM training were that trainees lacked an understanding of the rifle zeroing process and that inadequate feedback was available to soldiers about shots fired at distances beyond 25

² Research conducted between 1977 and 1980 has been summarized in an earlier report (Smith, Osborne, Thompson & Morey, 1980).

Table 1
Summary of Problems Identified in BRM Training³

TRAIINEES

- Limited ability to maintain and operate rifle.
- Limited knowledge of shooting fundamentals.
- Little knowledge of zeroing process.
- Poor zero achieved by many.
- Limited knowledge of effects of wind and gravity.

INSTRUCTORS

- Too few competent instructors.
- Limited BRM knowledge.
- Limited diagnostic skills.
- Unable to conduct effective remediation.

RANGES, TARGETS AND TRAINING AIDS

- Difficulty using zeroing targets.
- No feedback on quality of pop-up target hits.
- No feedback on pop-up target misses.

WEAPONS

- Insufficient quality checks.
- Hard trigger pull for some rifles.
- Poor grouping ability of some rifles.

³Smith, Osborne, Thompson and Morey, 1980.

meters. Another field experiment addressed these problems by investigating the effects of a revised zeroing target and down-range feedback training upon the record fire performance of 2,124 basic trainees (Smith, Thompson, Evans, Osborne, Maxey & Morey, 1980).

The intent of the revised zeroing target (see Appendix A) was to simplify the zeroing process and make it more meaningful to the soldier. After locating the shot group center, the trainee could look to the margins of this target and determine the appropriate number of clicks (increments of vertical and lateral adjustment) and the direction in which to move the sights. Further, the target provides cues about shooting performance at more distant targets. If a trainee can keep all bullets within the circle of this 25-meter target, he has shown his capability to hit targets out to 300 meters in later field firing. If the trainee cannot, the target serves as a visible record of performance and identifies him as needing remedial assistance.

Down-range feedback training involved firing at paper silhouette targets on a modified field fire range at distances of 75 and 175 meters (see Appendices B and C). After firing a shot group at each of these targets, each trainee walks down range and places spotters in the bullet holes. These spotters are large enough to be seen from the firing line, enabling instructors to easily determine those trainees needing remedial aid.

When compared with standard training, a significant increase in record fire performance was found when the revised zeroing target was used ($p < .005$). A significant increase was found when down-range feedback was added ($p < .001$), and an even greater increase was found when both were added to training ($p < .001$). It was concluded that the revised zeroing target and down-range feedback training would become parts of a projected new BRM program (Smith, Thompson, Evans, Osborne, Maxey and Morey, 1980).

Due to concern about the accuracy of published information on the capabilities of the M16A1 rifle and the general negative opinions expressed by many soldiers, a series of pilot tests was conducted in order to gain more knowledge about the M16A1 and the impact its performance might have on training (Osborne, Morey & Smith, 1980). Drawn at random from training companies and weapons pools at Fort Benning, 60 weapons were subjected to a series of non-firing and firing tests, although a representative smaller sample from these 60 was used in several other tests. Seven major findings were obtained:

1. The average M16A1 rifle is capable of firing shot groups that easily fit within the four-centimeter circle of the revised zeroing target, and hence could be expected to hit all targets out to 300 meters.
2. Available serviceability checks will eliminate an unserviceable rifle, but may not detect a poorly shooting weapon. If a trainee is shooting poorly, there is a small chance that it could be the fault of his weapon. Only a test firing by a competent marksman can rule out the weapon as a problem.

3. Trigger pull ranged from 5.5 to 10.5 pounds, with a median of 7.5 pounds. Although the shot group sizes of experienced shooters did not increase with greater pull weight, inexperienced trainees could encounter problems with M16A1 rifles having trigger pulls within this greater than average range.

4. Tests confirmed the published trajectory of the M16A1 (firing the M193 bullet) and indicated that the 25-meter zeroing procedure, adjusting sights to hit 2.4 centimeters below point of aim, results in an acceptable 250-meter battle sight zero.

5. The barrel of the M16A1 was found to be easily distorted by varying pressure applied forward of the receiver. When compared with normal firings from sandbag support, use of a hasty sling causes bullets to strike lower and use of a bipod causes higher shots. In fact, the difference in bullet strike between these barrel stress sources can be as much as two to four feet at 300 meters.

6. Using M16A1 standard sights, it was found that failure to center the top of the front sight in the rear sight aperture was not likely to cause a hit error of greater than six inches at 300 meters.

7. Using the long range sight, it was found that zeroing could be accomplished by adjusting bullet impact to coincide with point of aim at 25 meters. After adjusting point of impact to point of aim at 25 meters using the long range sight, an acceptable 250-meter battlesight zero automatically exists whenever the regular sight is subsequently employed.

Because using the long range sight enables one to hit where he is aiming at 25 meters, the need to use a more complex 25-meter zeroing procedure, in which point of impact is adjusted to fall 2.4 centimeters below point of aim, is eliminated. For use with the long range sight, a 25-meter zeroing target composed of a solid black 250-meter scaled silhouette was compared with the Canadian bull aiming point on the revised ARI zeroing target. At 25 meters, the scaled silhouette target presents the firer with a visual perception similar to that of an actual E-type silhouette viewed at 250 meters. Using an aiming point that is center of mass of the silhouette during 25-meter firing allows for the development of this important skill while precise bullet location feedback is available. Additionally, it was found that shot group size did not deteriorate when the scaled silhouette target was used in lieu of a Canadian bull aiming point (Osborne, Morey & Smith, 1980).

Additional training exercises were developed based on two other 25-meter scaled silhouette targets designed to portray field-fire targets trainees engage during BRM. A slow fire target having six scaled silhouettes was designed to give trainees additional practice in marksmanship fundamentals prior to field firing (see Appendix D). A timed fire target having ten scaled silhouettes was also designed to provide practice in the rapid application of marksmanship fundamentals prior to practice record fire (see Appendix E). Firing at these targets at 25 meters with the long range sight, students receive precise feedback about the exact location of both hits and misses. Feedback trainees receive in the field-fire environment is much less precise.

Training exercises incorporating scaled silhouette targets can also function as important diagnostic checkpoints in an overall marksmanship program. If soldiers cannot hit the scaled targets, there is no reason to expect that they will be able to hit targets at actual range until appropriate remedial training is conducted.

Incorporating potential improvements identified through previous research, a revised BRM training program was developed and subsequently tested with 1,151 male and female soldiers at Fort Jackson, South Carolina, in 1979 (Thompson, Smith, Morey & Osborne, 1980). Compared with standard training, the major differences in this BRM program included the following:

1. A revised 25-meter zeroing target that is easier to understand and provides cues about shooting performance at more distant ranges (Smith, Thompson, Evans, Osborne, Maxey & Morey, 1980).
2. Scaled silhouette target exercises (Osborne, Morey & Smith, 1980).
3. Down-range feedback exercises (Smith, Thompson, Evans, Osborne, Maxey & Morey, 1980).
4. Instructor emphasis on a simplified set of four marksmanship fundamentals: steady position, aiming, breath control, and trigger squeeze.

It was found that soldiers receiving the revised BRM training had significantly higher ($p < .001$) record fire scores than did those receiving standard training. This experiment demonstrated that substantial increases in record fire performance could be achieved, even with limited program resources (Thompson, Smith, Morey & Osborne, 1980).

Additional refinement and testing of the revised BRM program was performed with over 8,000 soldiers receiving Initial Entry Training (IET) at Fort Benning. Two noteworthy changes were made during this process. First, a 250-meter scaled silhouette was added to the revised 25-meter zeroing target for use with the long range sight. Aiming at the center of mass of this silhouette, soldiers adjust bullet impact to fall within a four-centimeter circle (see Appendix F). Second, a three-hour period of instruction entitled "Combat Fire" was added to the POI. During combat fire trainees fire up to 50 rounds at 40 targets, firing additional rounds at targets that are initially missed. As proponent for M16A1 rifle marksmanship training, the Assistant Commandant of the USAIS approved the new BRM program in 1980. Implementation of the program was completed at all ATCs in 1982.

In summary, the new BRM training program emphasizes five major points (Smith, Osborne, Thompson & Morey, 1980):

1. It stresses simplified fundamentals before moving on to field-firing exercises.
2. It contains several diagnostic check points so that early problem detection and correction can occur.

3. It incorporates a natural progression from fundamentals to the rapid engagement of targets in a combat-like setting, with each exercise serving as a building block for the one that follows.

4. It places major emphasis on precise and timely feedback, so trainees receive as much knowledge of their shooting performance as present technology and expense will permit. This enables poor shooters to correct their mistakes and good shooters to sharpen their skills.

5. Finally, the program is designed to help instructors become more effective teachers. As an aid to this process, the Basic Rifle Marksmanship Trainer's Guide was prepared, tested, refined, and then fielded throughout the Army (U.S. Army Infantry School, 1982).

A comparison of the previous BRM training program and the new M16A1 BRM POI is shown in Table 2.

Advanced Rifle Marksmanship

The ARM program existing in 1981 was initially analyzed by ARI/Litton researchers. Based upon observation, participation, and informal interviews with instructor personnel, the following three major shortcomings in the ARM program were identified:

1. The overall concept of ARM training was limited to automatic fire and night fire only.
2. Training in automatic fire and night fire was inappropriate, from both a combat realism and a learning/cognition viewpoint.
3. Feedback provided to soldiers about their performance was neither timely nor precise.

If an ARM program is to be truly advanced, as its name implies, then the ARM program should teach the 11B soldier those important marksmanship skills, in addition to automatic fire and night fire, that he will be required to perform in an infantry unit. In order to identify the most important marksmanship skills required of infantrymen, but which had not been taught in BRM, an extensive analysis of Army Training and Evaluation Programs (ARTEPs) was performed for both the Infantry (ARTEP 7-15) and the Mechanized Infantry (ARTEP 71-2). From this analysis of the expected role of small arms in infantry missions, the areas of quick fire, suppressive fire, and firing at moving personnel targets were identified for inclusion in an improved ARM program.

Training being conducted in automatic fire and night fire was found to be inappropriate. For example, a soldier could increase his score on any automatic fire scenario by simply firing in the semi-automatic mode. Ideally, an appropriately designed automatic fire scenario would enable soldiers to achieve higher scores when firing full automatic, than when firing semi-automatic. Automatic fire target exposure times were found to be over 50%

Table 2

Comparison of the Previous Basic Rifle Marksmanship Training Program and the New M16A1 Basic Rifle Marksmanship Program of Instruction

PREVIOUS MARKSMANSHIP TRAINING PROGRAM				NEW MARKSMANSHIP TRAINING PROGRAM			
PERIOD	SUBJECT	HOURS	ROUNDS	PERIOD	SUBJECT	HOURS	ROUNDS
1	Orientation and Mechanical Training	4	0	1	Introduction and Mechanical Training	4	0
2	Preparatory Marksmanship Training	3	9	2	Fundamentals of Shooting (Dry Fire)	4	0
3	Preparatory Marksmanship Training	3	9	3	Fundamentals of Shooting (Live Fire)	4	9
4	Twenty-Five Meter Firing	4	24	4	Practice Firing (Zero)	8	18
				5	Practice Firing (25-m Silhouette)	2	18
				6	Downrange Feedback (75 m and 175 m)	8	30
				7	Field Fire (Single Targets and Target Detection)	4	42
				8	Field Fire (Single and Multiple Targets)	4	36
				9	Confirmation of Zero and Timed Fire (25-m Silhouette)	4	32
				10	Practice Record Fire	4	40
				11	Record Fire/Combat Fire	7	90
				12	Automatic Firing	2	21
				13	Protective Mask Firing	2	20
				14	Night Firing	3	30
					Totals	37	334
						Totals	60
							386

longer than the average target exposure times found in BRM. In order to make the automatic fire training conducted in ARM more appropriate, it was suggested that the target exposure times be greatly reduced during automatic field fire. Further, night fire training was found to be inadequate, as it involved nothing more than firing rounds down range at night. Targets could not be seen, scores were not kept, and trainees never knew whether or not they hit any targets. When Starlight scopes were used, they were not zeroed with the rifles. Two improvements made in the night fire period of ARM were the use of artificial illumination to briefly expose the targets to firers and the use of Starlight scopes zeroed with the rifles.

Performance feedback provided to soldiers was found to be neither timely nor precise. Because performance feedback is an essential aspect of any effective training program, the amount of feedback given to soldiers was increased as much as possible in the revised ARM program. For example, the amount of firing conducted with scaled silhouette targets on 25-meter ranges, where soldiers can walk down range to inspect and score targets, was increased. In addition, soldiers walk down range to inspect and score targets during both quick fire and night fire.

A comparison of the new and previous ARM programs is shown in Table 3. In lieu of additional automatic fire training, three new periods were added to the new program: quick fire, rapid semi-automatic and suppressive fire, and engaging moving personnel targets. Quick fire training requires the soldier to fire fast, instinctively aimed shots at targets from close range. The ability to quickly and instinctively align the barrel with a target is needed in those combat situations where an immediate reaction to a threat is more important than highly accurate fire. During quick fire training soldiers fire at a full-size E-type silhouette from ranges of 15 and 25 meters. Rifle sights are covered with tape to prevent conventional aiming and soldiers fire from a standing position while looking down the barrel over the top of the sights.

Rapid semi automatic fire represents a logical extension of the four fundamentals of rifle marksmanship taught in BRM. Steady position, aiming, breath control, and trigger squeeze are still emphasized in rapid semi-automatic fire training. The only difference is that the soldier must gradually learn to employ these skills in a minimum amount of time. In BRM the soldier has a minimum of at least three seconds in which to fire every round. The goal of rapid semi-automatic fire training is to increase the rate of accurate fire which a soldier is able to deliver. Using the 25-Meter Scaled Silhouette Timed Fire Target found in BRM (see Appendix E), trainees fire twenty rounds within a time limit of 45 seconds during ARM.

Rapid semi-automatic fire is also utilized during training in suppressive fire, where accuracy of fire and a high volume of fire may be equally important considerations. Infantry ARTEP analyses indicated that there will probably be fewer opportunities in a combat environment to fire at clearly defined personnel targets than there will be to fire at poorly defined point and area targets (or suspected enemy locations) that are covered and/or concealed.

Table 3

Comparison of New and Previous Advanced Rifle Marksmanship Training Programs

PERIOD	PREVIOUS ARM PROGRAM			NEW ARM PROGRAM		
	SUBJECT	HOURS	ROUNDS	PERIOD	SUBJECT	HOURS
1	Obtain Battlesight Zero with Bipod	4	39	1	Quick Fire	4
2	Automatic Rifle Field Fire	4	96	2	Rapid Semi-Automatic and Suppressive Fire	30
3	Automatic Rifle Qualification (Practice)	4	96	3	Automatic Rifle Field Fire ⁴	50
4	Automatic Rifle Qualification (Record)	4	96	4	Night Fire	96
5	Night Fire	3	27	5	Engage Moving Personnel Targets	54
	Total	19	354		Total	24
						302

⁴ The final 15 rounds in automatic field fire are fired while wearing the M17 protective mask.

Suppressive fire training in ARM is an attempt to move beyond the clearly defined and fully exposed silhouette targets found in BRM. In lieu of constructing a range specifically for suppressive fire training, a realistic paper target was developed for this purpose. The 25-Meter Scaled Landscape Suppressive Fire Target was designed to enable soldiers to learn rapid semi-automatic and suppressive fire skills on a 25-meter range (see Appendix G). Three scaled point or area targets are presented on this landscape target: a house window, a fence and hedgerow, and an armored vehicle. The soldier obtains the same visual perception in relation to the rifle's front sight post at 25 meters as he would if he were actually firing at a house window at 200 meters, a fence/hedgerow at 250 meters, or an armored vehicle at 300 meters.

Impetus for the creation of a moving target engagement period came from the realization that a primary firing course of the future, the Defense Test Range (DTR) equipped with the Infantry Remoted Target System (IRETS), will include moving targets as a large part of its scenario. For a soldier to successfully engage an advanced threat scenario on a DTR, he must not only be able to engage moving targets, but he must be able to engage an almost overwhelming mixture of moving and stationary targets with minimum delay. Exposure times on proposed advanced threat scenarios are generally less than those in BRM and more targets are exposed simultaneously on such scenarios than in BRM.

Previous doctrine outlined four different points of aim for laterally moving personnel targets (FM 23-9). Determining which of these four lead rules to use required the soldier to estimate the range and speed of the target. Given this fact, hitting moving personnel targets within an exposure time of a few seconds is probably too complex a task for most soldiers to master during limited training. In an attempt to simplify established procedures for engaging moving targets, nine different lead rules were subjected to a trigonometric analysis to determine the theoretical location of bullet impact (Evans & Schendel, 1982). The following five variables were considered in this analysis: target speed, angle of movement, target range, size of the front sight post, and velocity of the 5.56mm M16A1 projectile. A single lead rule was found which is appropriate for all target speeds, angles of movement, and target ranges out to 200 meters. By aligning the trailing edge of the front sight post with the center of the target, all IRETS moving targets could be hit. Given the fact that a single lead rule was desired to simplify training and maximize the number of high-priority target hits, this lead rule is taught for all moving targets in the new ARM program. Prior to engaging moving field-fire targets, soldiers are given moving target dry fire training. In addition, soldiers fire at a 25-Meter Scaled Simulated Moving Target (see Appendix H). This paper target allows soldiers to practice the lead rule with stationary targets prior to engaging moving targets. Soldiers then walk down range to inspect their targets. If rounds hit within a dotted silhouette which is offset from the solid silhouette at which one aims, the round probably would have hit the target if it had actually been moving.

It should be noted that the new ARM training program is an attempt to improve this instruction within the constraints of available resources. An ideal ARM program would differ in some respects; for example, greater numbers of trained instructor personnel would be used and electronic projec-

tile location equipment would be employed to improve the performance feedback provided to trainees. Further information concerning the development of the ARM POI is contained in a separate report (Evans & Schendel, 1982).

Unit Rifle Marksmanship

Unit rifle marksmanship training must consider both individual and collective firing proficiency. The individual portion of the unit marksmanship program is designed to insure skill retention and improvement, while the collective portion of the program is focused on the application of those skills in a group tactical environment. Unit marksmanship programs must be designed with flexibility, in order to support the particular training environment of various units. Because time, facilities, and ammunition available for training vary among Active and Reserve Component units of the Army, marksmanship training must vary also.

It is recommended that most units conduct marksmanship training at least once every quarter. Table 4 outlines the individual firing portion of a sample annual unit training program (FM 23-9; change 3). This program includes three days of training in conjunction with annual qualification, a two-day biannual refresher, and two one-day quarterly refreshers. With the exception of quick fire, marksmanship topics parallel those taught in the BRM program. Mechanical training/dry fire, shot grouping/zero, known distance (KD) or scaled silhouette firing, and protective mask firing are to be conducted quarterly. Field fire, practice record fire, competition firing, and night fire are scheduled biannually. Record fire, automatic fire, and quick fire are conducted annually.

Selected components of the unit training program were pilot tested with the 82nd Airborne Division, Fort Bragg, North Carolina, during three different weeks in 1981 and 1982. Further testing was conducted with the 1st Infantry Division, Fort Riley, Kansas during one week in 1982. Late in 1982, a more extensive evaluation of the unit program was conducted with two companies of the 197th Infantry Brigade, Fort Benning, Georgia. A two-day instructor training program was initially conducted with non-commissioned officer personnel. Instructor training included classroom instruction, preparatory marksmanship/dry fire exercises, and 25-meter live firing. Following instructor training, a 24-hour unit marksmanship program was conducted.

The first day of unit training was devoted to preparatory marksmanship and 25-meter instructional firing. Marksmanship fundamentals and the principles of zeroing were introduced. Supervised dry firing, shot grouping with the "ball and dummy" technique, and zeroing were then conducted. Finally, each soldier fired the FORSCOM Commander's Company Level Marksmanship Competition twice, once for practice and once for record (FORSCOM Circular 350-81-1). This competitive exercise consists of ten rounds fired at five 250-meter silhouette targets scaled for 25 meters (FORSCOM C-10, 1 Jan 81). A reduced copy of the FORSCOM 25-Meter Competitive Rifle Target is contained in Appendix I. Maximum total score for each firer is 100 points. At the conclusion of this single day of training, company average scores for the record firing were 59.70 and 54.52. Three months before this training was conducted,

Table 4

Summary of the Individual Portion of an Annual
Unit Rifle Marksmanship Training Program

TRAINING	ANNUAL UNIT TRAINING PROGRAM			
	3 DAYS _____QTR	1 DAY _____QTR	2 DAYS _____QTR	1 DAY _____QTR
Mechanical Training/ Dry Fire	X	X	X	X
Shot Grouping/Zero Known Distance (Note 1)	X	X	X	X
Scaled Silhouette (Note 2)	X			
Field Fire	X		X	
Protective Mask Fire	X	X	X	X
Practice Record Fire	X		X	
Record Fire	X			
Competition Firing	X		X	
Night Fire		X		X
Automatic Fire		X		
Quick Fire				X

Note 1: Used in place of scaled silhouette exercise.

Note 2: Used when a known distance range is not available.

AMMUNITION: The annual ammunition expenditure for individual marksmanship training is 750 rounds, 5.56 ball, based on training requirements for an Infantry rifleman (TC 25-3, Training Ammunition).

the same two companies had fired averages of 11.91 and 9.87, respectively, on the same competitive exercise. The remainder of the unit training program tested included 12 hours of known distance (KD) firing and 4 hours of night fire.

In addition to the on-the-ground program evaluations, components of the program have been implemented by several units. In the majority of cases, training material was provided by mail and additional coordination was conducted by telephone. This type of implementation has occurred within selected units in Germany, Korea, Alaska, Hawaii, and within units located at Forts Hood, Lewis, Stewart, Campbell, and Polk.

The collective firing portion of unit marksmanship training is less standardized than the individual firing portion, due to differing mission requirements across units. To support units in conducting their own individualized training programs, the Unit Rifle Marksmanship Training Guide was developed (Osborne, Evans, Lucke & Williams, 1982). This comprehensive guide contains separate sections on a variety of marksmanship activities that can be implemented by a unit as their training schedule permits. The following sections of the guide are most pertinent to collective training within units:

1. Infantry Trophy Match
2. Assault Fire
3. Prepared Defensive Firing
4. Combat Firing Course
5. Engagement of Aircraft
6. Unit Live Fire Exercises
7. Suppressive Fire
8. MILES
9. Using Marksmanship Experts
10. Train the Trainer
11. How to Coach
12. Development of an Effective Unit Marksmanship Program

In addition, other sections of the guide are devoted to basic and advanced individual marksmanship skills. These sections include:

1. Marksmanship Fundamentals
2. Dry Fire
3. Grouping
4. Shot Group Analysis
5. Zeroing
6. Rifle Sights
7. Ballistics
8. Scaled Silhouette Targets
9. Effects of Range
10. Effects of Gravity
11. Effects of Wind
12. Effects of Target Movement
13. Downrange Feedback
14. Known Distance (KD) Firing
15. Field Firing

16. Company Level Competition
17. Qualification Firing
18. Protective Mask Firing
19. Automatic Firing
20. Night Firing
21. Quick Fire
22. Firing Positions
23. Fun Shooting
24. .22 Rim Fire Adapter
25. Weaponeer
26. Training Aids and Devices
27. Target Requirements
28. Ammunition Requirements
29. Range Requirements
30. Rifle Maintenance and Serviceability
31. Capabilities of the M16A1 Rifle
32. Rapid Semi-Automatic Fire

Additional information concerning unit rifle marksmanship training may be found in the separate training guide (Osborne, Evans, Lucke & Williams, 1982).

THE PROCESS OF IMPLEMENTATION

The process of implementing basic, advanced, and unit rifle marksmanship training programs involved much more than simply providing new programs of instruction to training personnel. This section outlines a diverse array of research and development efforts that supported the implementation process. For clarity of presentation, these largely interrelated efforts are detailed within the areas of equipment research, target design, range modification, training devices, and instructor training.

Equipment Research

In designing a rifle marksmanship training program, an understanding of both the positive and negative operational characteristics of the rifle system is essential. The most systematic and comprehensive equipment research effort conducted to date focused on the adequacy of M16A1 rifle performance and its implications for marksmanship training (Osborne, Morey, & Smith, 1980). Major findings from this investigation were presented in an earlier section (see pages 4-5). In addition, less structured equipment analyses have been conducted in four other areas: maintenance and rifle magazines, Starlight scopes, night sights, and the M16A2 rifle.

Maintenance and Rifle Magazines. Numerous observations of rifle marksmanship training at basic, advanced, and unit levels have led to the conclusion that the incidence of rifle malfunctions is excessive. It appears that the majority of these malfunctions may be attributed to bad magazines. Unfortunately, no reliable procedure currently exists for identifying bad magazines.

and removing them from the system. While a device has been developed to identify bent magazine lips, many magazines that are slightly bent will function properly in some rifles, but not in others. Further, it may be cost prohibitive to replace all of the apparently bad magazines within the Army. Osborne, Morey, and Smith (1980) have indicated that existing serviceability checks will eliminate an unserviceable rifle, but may not detect a poorly shooting weapon. Osborne (1983) has recommended that development efforts for a new service rifle should give consideration to the design of improved magazines and serviceability checks. More specifically, consideration should be given to the construction of a sturdier magazine, a more positive operating magazine, and/or one that fits more securely into the magazine well. In addition, development efforts for a new rifle should include built-in serviceability checks that will ensure that accurately firing weapons will be issued from the maintenance units.

Starlight Scopes. The AN/PVS-2 and AN/PVS-4 Starlight scopes can significantly increase the effectiveness of small arms fire at night, since they allow the shooter to more clearly see his target. However, several design characteristics of these night vision devices, particularly the AN/PVS-4, make them difficult to use effectively without thorough and extensive training. Informal test firings and unstructured interviews with marksmanship instructors at Fort Benning revealed that the primary limitation of Starlight scopes is that they are difficult to zero and to keep zeroed to one's rifle. Due to variability among rifles, a Starlight scope must be zeroed with a particular rifle and it must be rezeroed whenever it is mounted on another rifle. Further, adjusting the objective or diopter focus of the scope causes the reticle to move slightly, which often results in the zero being lost. This problem appears to be greater in the AN/PVS-4, which will eventually replace the AN/PVS-2 in all units. Changing the focus of scopes is unavoidable, particularly in a training environment where there are many more soldiers than there are Starlight scopes. Not only must the objective focus be adjusted to engage targets at different ranges, but the diopter focus must be adjusted for the vision of different firers.

To further complicate the training process, the AN/PVS-2 and AN/PVS-4 differ in many important respects, including the following:

1. Mounting and dismounting procedures differ.
2. Zeroing procedures are different.
3. Windage and elevation adjustments on the AN/PVS-2 are made in the direction of the error, while adjustments on the AN/PVS-4 are made in the direction of the desired point of impact.
4. Reticle patterns on the two scopes differ widely. The AN/PVS-2 has a relatively small and simple T-shaped reticle, while the reticle on the AN/PVS-4 is complex and difficult to use.

Due to these major differences between the two scopes, much of the learning which takes place as a result of training with the AN/PVS-2 is not likely to transfer to the AN/PVS-4, or vice versa.

In reality, it is difficult to find units in which a Starlight scope has been zeroed to a particular weapon with an operator knowledgeable in its use. This is not surprising, since the only formal Starlight scope training program for the M16A1 found within the Army involves approximately two hours of familiarization during ARM. Units are currently responsible for training soldiers to become proficient in using Starlight scopes. In an effort to assist units with the difficult task of Starlight scope training, a section of the Unit Rifle Marksmanship Training Guide outlines the major differences between the AN/PVS-2 and AN/PVS-4, and presents suggested zeroing procedures and training exercises (Osborne, Evans, Lucke & Williams, 1982). However, it is also recommended that future efforts to develop an improved Starlight scope should give consideration to the design of a simple reticle, together with the development of an uncomplicated and reliable zeroing procedure which is unaffected by focus adjustment.

Night Sights. An improved night sighting system is currently needed for the service rifle. Many U.S. Army units have M16A1 rifles equipped with the Low Light Level Sight System (LLLSS), which incorporates a 7mm rear aperture and a front sight post containing luminous material. It is erroneous to consider the LLLSS to be a night sight, as its only advantage over standard sights is that it is more effective during the limited hours of Beginning Morning Nautical Twilight (BMNT) and Ending Evening Nautical Twilight (EENT). In fact, the LLLSS has been found to severely complicate training procedures and to degrade daylight shooting performance, without increasing hit probability at night. Both the front sight and the rear sight of the LLLSS are inappropriate for effective rifle alignment at night, as they each tend to obscure the target.

In an effort to find a substantially improved night sighting system, a variety of such systems has been informally tested. The most effective device tested to date was a laser aiming light, which is adjusted to place a red laser dot on the target. Although its utility for combat is questionable and its cost is high, all personnel who fired with the device received a near 100% hit rate at 50-meter targets on the BRM night fire range at Fort Benning, Georgia.

It has been recommended that an improved night sighting system be developed concurrently with the M16A2 rifle (Osborne, 1983). One such system which has been recommended for evaluation incorporates a series of four luminous dots, two on the front sight guards and two placed high on the rear sight housing. These four dots are aligned horizontally, with the target placed in the center of the two central dots of the sight picture. Another version of this night sight under investigation uses a single dot for rear alignment, placed high at the forward portion of the receiver and flipped to an upward position for use. These recommended night sighting systems have been described in greater detail by Osborne (1983).

M16A2 Rifle. The M16A2 rifle is the result of a Product Improvement Program (PIP) and was type classified in September 1982. It is currently being produced by Colt Industries for the U.S. Marine Corps. Under contract to ARI, an analysis of new features of the M16A2 was performed. Details of this analysis have been presented in a separate report (Osborne, 1983).

Osborne (1983) has outlined the contrasting marksmanship training philosophies employed by the Army and Marine Corps and their relationship to characteristics of the M16A2. In particular, Army requirements were discussed in detail from a training development perspective and recommended rifle improvements considered optimum for Army use, while simultaneously meeting Marine Corps requirements, were presented.

Primarily, eight features of the M16A2 distinguish it from the M16A1. The following are the changed equipment features which have been incorporated in the M16A2:

1. A new barrel that is somewhat heavier at the muzzle and that has a 1:7-inch twist, rather than the 1:12-inch twist of the M16A1. The M16A2 was designed to fire the XM855 NATO ammunition.
2. A new muzzle-compensated flash suppressor.
3. A square front sight post for elevation adjustment.
4. A differently shaped handguard made of more durable material.
5. A strengthened upper receiver, including a brass deflector rib, which supports a new rear sight. The rear sight has a horizontal wheel which is adjustable for ranges between 300 and 800 meters, using a 1-3/4mm aperture. When the sight is set for 300 meters, pushing the flip-type sight forward provides a 5mm aperture for ranges between 0 and 200 meters. A drum-type knob is used for windage adjustment.
6. The "automatic" firing mode has been replaced with a "burst" mode which fires a maximum of three rounds for each trigger pull.
7. The pistol grip, constructed with more durable material, has also been remolded to provide for finger grooves.
8. The butt stock has been lengthened by 5/8 inch and is constructed with more durable material. The butt plate is made of tougher material and is designed to minimize slippage.

From an Army training development perspective, however, the M16A2 which was type classified appears to have 22 major disadvantages. A brief summary of these shortcomings, discussed in greater detail by Osborne (1983), is presented below.

1. The M16A2 does not have a sight setting for 25-meter firing, where zeroing and most practice firing occurs.
2. The M16A2 does not have a sight setting for a 250-meter battlesight zero.
3. The 5mm and 1-3/4mm apertures of the M16A2 are inappropriate for firing at ranges between zero and 300 meters, because a single optimum sight is needed for this high-priority range band.

4. The M16A2 sighting system is overly complex. For example, there are three different ways elevation may be changed, leaving considerable room for soldier error.
5. Sight movements on the M16A2 can change the location of bullet impact by four different amounts (.5, 1, 1.5, and 3 minutes of angle). The sights intended for zeroing are also not compatible with Army zeroing targets.
6. The M16A2 does not have a sighting system that allows easy recording and visual confirmation of rifle zero.
7. The M16A2 does not have a reliable procedure for returning to an individual's zero setting after sights have been changed for any reason (e.g., using MILES or .22 rim fire adapters).
8. The M16A2 does not have a night sight.
9. The M16A2 has not been designed to aid firing while wearing a protective mask.
10. The M16A2 sight has not been designed to aid in the estimation of range.
11. The M16A2 sight has not been designed to aid in the engagement of moving targets.
12. The M16A2 front sight is subject to bending, causing various amounts of change to windage adjustments when elevation adjustments are made.
13. The M16A2 rear sight is subject to binding and it must be kept clean and well lubricated.
14. The new ammunition (XM855) cannot be fired in the M16A1.
15. Data indicate that the M16A2 (XM855 ammunition) is less accurate than the M16A1 (M193 ammunition) out to ranges of 500 meters.
16. The M16A2 (XM855 ammunition) appears to be less reliable, exhibiting greater numbers of failures to fire than the M16A1 (M193 ammunition).
17. The M16A2 has less combat versatility due to the elimination of the full automatic mode of fire.
18. The increased heaviness of the M16A2 barrel does not alleviate the problem of temporary barrel bending, which occurs from the differing stress of various firing positions and which causes the location of bullet impact to vary as a result. (An additional barrel modification is being considered.)
19. The M16A2 barrel has a 1:7-inch twist, although available data indicate that a 1:9-inch twist would be more appropriate.

20. The M16A2 stock is too long for Army use. In fact, the M16A1 stock is already too long for some smaller-framed soldiers (mostly females).
21. The M16A2 may not be able to accommodate the .22 rim fire adapter without an excessive loss of accuracy and excessive fouling of the barrel.
22. The M16A2 does not include several needed features: improved serviceability checks, improved magazines, an improved trigger, or a system for obtaining a mechanical zero.

It should be noted that 10 of the 22 listed disadvantages of the M16A2 likewise apply to the M16A1. For this reason, a list of recommended Army rifle features was developed which reflects training development considerations and which appears to have the highest probability of resulting in optimum combat performance. In summary, Table 5 briefly compares the major design features of the M16A1, the M16A2, and the recommended Army rifle (Osborne, 1983).

Target Design

A variety of M16A1 rifle targets have been developed and evaluated in support of the basic, advanced, and unit rifle marksmanship training programs. The purpose of these target design efforts was to simplify the marksmanship training process, to make it more meaningful for the soldier, and to provide precise feedback about the location of hits and misses. Of the 13 targets currently being used in rifle marksmanship training, 10 will become standard U.S. Army targets with the publication of change 3 to FM 23-9.

Standard Targets. Five of the ten standard U.S. Army targets have been previously described in this report. These include the 75-Meter and 175-Meter Down-range Feedback Targets (see page 4 and Appendixes B and C), the 25-Meter Slow Fire and Timed Fire Scaled Silhouette Targets for M16A1 Rifle with Standard Sights (see page 5 and Appendixes D and E), and the Standard 25-Meter Zeroing Target for M16A1 Rifle with Standard Sights (see page 6 and Appendix F).

Three 25-meter targets were designed for M16A1 rifles equipped with the LLLSS. Because the LLLSS does not include a long range rear sight, the regular 2mm rear aperture (marked "L") must be used for all daylight firing. This rear sight results in a trajectory which is 2.4 centimeters below point of aim at 25 meters. For this reason, targets developed for use with the LLLSS have dotted silhouettes that are superimposed 2.4 centimeters below the solid black silhouettes at which one aims. The 25-meter series of targets for the LLLSS includes a zeroing target (see Appendix J), a slow fire target (see Appendix K), and a timed fire target (see Appendix L).

Two additional targets were developed for units that must train and qualify annually on 25-meter or 15-meter (50 feet) ranges. Each includes 10 scaled silhouettes that are perceived to be at distances of 50, 100, 150, 200, 250, and 300 meters when viewed at the appropriate range. Reduced copies of

Table 5
Comparison of Design Features of the M16A1, M16A2,
and a Recommended U.S. Army Rifle

ITEM	M16A1	M16A2	RECOMMENDED
Front Sight (Standard)	Adjustable round post .065" wide. 1 click = 1 MOA.	Adjustable square post .070" wide. 1 click = 1.4 MOA.	Fixed blade .090" wide.
Front Sight (Low Light Level)	Adjustable round post .095" wide with luminous vial in center of post. 1 click = 1.25 MOA. Must be turned 2 clicks for vial to show = 2.5 MOA.	None.	A luminous dot on each sightguard.
Rear Sight (Standard)	Flip-type peep. Back is 2mm peep used for 250-m zero. Forward marked L, is 2mm used for 25-meter firing (zeroing with point-of-aim/point-of- impact) and a zero for 375 meters. Windage adjustment is made with a flat slotted wheel, 1 MOA per click.	Flip-type peep. Elevation drum built into carrying handle has 25 clicks (.1 MOA ea.) of elevation adjustment and markings for 3, 4, 5, 6, 7, and 800 meters. Back flip sight is 1-3/4mm and used for 300 through 800-meter firing. The forward flip is 5mm and is used from zero to 200 meters, with the drum set for 300 meters, and for moving targets, close combat and reduced light. Windage adjustments are with a drum-type knob, .5 MOA per click.	A single 2mm peep. A single elevation knob marked for 200, 250, 300, 25, 400, 500, 15, 600, 700, and 800 meters. Windage knob at rear. Each click equal to 1 MOA.
Rear Sight (Low Light Level)	Flip type peep. Back is 7mm peep used for low light level firing. Forward is 2mm peep marked L, which is the regular sight for 250-meter zero. Windage adjustment is made with a flat slotted wheel, 1 MOA per click.	None.	Two luminous dots on upper portion of re- ceiver are aligned with front dots for shooting at night.

Note. A minute of angle (MOA) is equal to one inch at 100 yards or .7 cm at 25 meters.

Table 5 continued

<u>ITEM</u>	<u>M16A1</u>	<u>M16A2</u>	<u>RECOMMENDED</u>
Recording of Zero	Almost impossible.	Very difficult.	Simple.
Visual inspection of Zero	Impossible.	Impossible.	Simple.
25-m Setting (Standard Sights)	Not by design.	None.	Yes.
25-m Setting (Low Light Level Sights)	None.	N/A.	Yes.
Mechanical zero can be placed on the rifle.	No.	No.	Yes.
Battlesight (A sight setting for 250 meters)	Yes.	No.	Yes.
Firing Mode	Semi and Auto.	Semi and 3 round burst.	Semi and Auto.
Barrel	Light weight 1:12" twist.	Heavy at muzzle end. Light weight at receiver and mid-barrel. 1:7" twist. (Heavy barrel currently being tested.)	Slightly heavier at receiver and mid-barrel. 1:7" twist.
Handguard	Triangular in shape. Left and right sections different. Held in place with a difficult-to-move slip ring.	Round in shape and constructed of more durable material. Upper and lower sections identical. Held in place by an easy to move slip ring.	Same as M16A2 except held in place with a securely fastened ring nut to provide rigidity.
Butt Stock	Standard.	Constructed of more durable material. 5/8" longer.	Same material as M16A2. Same length as M16A1. Option for adjustable length.

the 25-Meter Alternate Course "C" Target and the 15-Meter Alternate Course "C" Target are contained in Appendixes M and N, respectively.

Other Targets. Previously described in this report, the 25-Meter Scaled Landscape Suppressive Fire Target (see page 11 and Appendix G) and the 25-Meter Scaled Simulated Moving Target (see page 11 and Appendix H) are undergoing continuing evaluation. Developed in conjunction with the U.S. Army Marksmanship Unit, the FORSCOM 25-Meter Competitive Rifle Target has also been previously described (see page 12 and Appendix I).

Range Modification

In support of improved marksmanship training programs, consultation was provided in the area of range modification. The purpose of these efforts was to enhance the amount of learning that could be gained with existing ranges and target mechanisms at Fort Benning and other ATCs. During the implementation process, range modification consultation was provided in four areas: down-range feedback, moving targets, "Moonglow" targets, and automated scoring.

Down-range Feedback. In order to increase the amount and quality of feedback concerning the location of bullet impact at ranges more distant than 25 meters, plans were developed to install paper targets on existing field fire ranges at distances of 75 and 175 meters. Having been previously discussed (see page 4 and Appendixes B and C), these plans were evaluated and later implemented at all ATCs lacking access to KD range facilities.

Moving Targets. An analysis of the Infantry ARTEP and Mechanized Infantry ARTEP identified the need for training in the area of moving target engagement (see pages 7-12). As part of the implementation of a revised ARM program at Fort Benning, consultation in moving target range design was provided to the Infantry Training Group. The availability of eight portable moving IRETS target mechanisms was identified. These targets and a protective berm were then installed at 75 meters on an existing Automatic Rifle Qualification range. Presented in detail in a separate report (Evans & Schendel, 1982), a scenario composed of both stationary and moving targets was developed for use on this modified range.

"Moonglow" Targets. A limitation of the BRM night fire range at Fort Benning was that soldiers could not see the 50-meter targets at which they were shooting, except for the fraction of a second during which a muzzle flash simulator illuminated the target. Not surprisingly, the average number of hits obtained out of 30 rounds fired was less than one per soldier. In an effort to improve the visibility of these night fire targets, the Infantry Training Group installed "Moonglow" devices on each target mechanism. This device primarily consists of a low power light which is connected to the target mechanism and is reflected onto the target itself. When "Moonglow" devices are used, the firer can see a clearly distinct target outline, enabling him to better align his rifle with the target.

Automated Scoring. Automated range scoring can increase the accuracy and consistency of scoring marksmanship performance. It can also reduce the

labor force required to operate a firing range. Procedures were developed to record target hits on field-fire and record fire ranges using the M31Al target holding mechanism and the M40 night firing target mechanism. These procedures have been detailed in a separate report (Smith, 1979).

Training Aids and Devices

A variety of developmental and evaluative research projects were conducted within the arena of training aids and devices. Specifically, seven separate projects were conducted in the following areas: graphic training aids, the Basic Rifle Marksmanship Shooter's Book, Waponeer, projectile location technology, moving target training materials, rimfire adapters, and a review of training materials.

Graphic Training Aids. Graphic training aids include items such as charts, diagrams, posters, slides, and transparencies. These training materials are utilized either in a classroom or on a firing range. Prior to the implementation of the BRM POI, both written and verbal input was provided to the Infantry Training Group and the Training and Audiovisual Support Center at Fort Benning. This input led to the production of a set of graphic training aids that are used in conjunction with the 14 periods of the BRM POI. Graphic training aids for BRM have been locally produced at other ATCs, using the materials developed at Fort Benning as a standardized guide.

Examples of the topics presented with the use of BRM graphic training aids include the following:

1. M16Al Rifle Parts
2. Four Fundamentals of Rifle Marksmanship
3. Zero Target
4. Point of Aim
5. Correct Sight Picture
6. Effects of Gravity on Bullets
7. Wind Effect on Bullets
8. Adjusted Point of Aim

In addition to these BRM graphic training aids, a set of graphic training aids was similarly developed for use in the ARM POI conducted at Fort Benning (Evans & Schendel, 1982).

Basic Rifle Marksmanship Shooter's Book. The Basic Rifle Marksmanship Shooter's Book is a pocket-sized booklet developed for the use of the initial entry soldier (Heller, Thompson, & Osborne, 1981). Its purpose is twofold. First, it provides the soldier with a reference to read and study as questions arise pertaining to any portion of BRM training. Second, it can be used to record one's marksmanship performance and progress during BRM. The location of hits and misses may be recorded on reduced copies of all BRM paper targets, while scorecards are provided for all periods in which pop-up targets are used. It is believed that more effective remedial or reinforcement training can be provided to those soldiers who have kept accurate records in this booklet (Heller, Thompson, & Osborne, 1981).

The Basic Rifle Marksmanship Shooter's Book was initially printed and informally evaluated with several companies of initial entry soldiers in 1981-82 at Fort Benning, Georgia. Comments received during this period of informal field testing led to minor refinement in the format and contents of the booklet, a second printing of which occurred later in 1982. Although this publication is still considered to be in the developmental stage at Fort Benning, it is currently being used, with little modification, by all initial entry soldiers at two other ATCs.

Weaponeer. Weaponeer is a training device that simulates the firing of an M16A1 rifle at stationary personnel targets. It incorporates a replay feature that visually displays movement of the rifle barrel for up to three seconds prior to firing. This enables an instructor to diagnose firer errors in the application of marksmanship fundamentals.

A guide for Weaponeer instructors and others sharing responsibility for rifle marksmanship training was developed from information obtained through informal interviews, field observations, and experimental research (Schendel & Williams, 1982). This guide describes the function and operation of major Weaponeer components, presents an analysis of basic problems encountered in using Weaponeer together with recommended techniques for overcoming these problems, discusses potential uses of Weaponeer, summarizes research conducted to test and evaluate the device, and provides an overview of how Weaponeer is currently used in the U.S. Army.

In summary, three major findings were found in the Weaponeer research conducted to date (Schendel & Williams, 1982). First, it appears that Weaponeer can be used to quickly and effectively diagnose shooting problems. A standardized set of diagnostic procedures was developed for use of Weaponeer during BRM training. Second, an over-reliance on Weaponeer as a cure-all for shooting problems was found. Third, it appears that using Weaponeer to conduct remedial training exercises is impractical, given a limited supply of Weaponeers and high demand for their use.

More recently, the USAIS identified a need for a Moving Target Marksmanship Trainer (MTMT). As a result, a preliminary investigation was made of Weaponeer II. Weaponeer II simulates the firing of an M16A1 rifle at both stationary and moving personnel targets. However, the future role of this moving target training device in U.S. Army marksmanship instruction has yet to be determined.

Projectile Location Technology. An experimental evaluation of the Superdart projectile location system was conducted using Australian soldiers as test subjects (Smith & Osborne, 1981). The Superdart system is a live-fire target device that electronically detects and locates the position of a passing supersonic projectile and displays its precise location to the firer via a video display unit (VDU). Projectile location is accurately determined, whether a target is hit or completely missed.

Experimental versus control comparisons were made of the ability of soldiers to hit both stationary and moving targets equipped with the Superdart system. Experimental subjects received the detailed and timely location

feedback from Superdart. In contrast, control subjects were given only the hit or miss feedback that is normally available from killable pop-up targets. Despite the soldiers having exhibited very high hit rates during pre-test measurements, a significant performance increase was found when Superdart feedback was introduced during stationary target firing ($p < .05$). A similar, though statistically insignificant, trend was found in the results of the moving target firing.

Because the Superdart system can sequentially detect and plot up to ten shots fired in the automatic mode, and because it is possible to detect misses that are as far as five meters from the target, the system could be used for training and testing suppressive, night, protective mask, and assault firing techniques. In summary, the investigators concluded that the Superdart equipment demonstrated potential usefulness in three areas (Smith & Osborne, 1981). First, it can assist both students and instructors by providing the precise and timely feedback necessary for the effective acquisition of marksmanship skills. Second, it can be used to develop information about what to train and how to accomplish that training. For example, the system might assist in determining the best techniques to employ when engaging a target with automatic fire. Third, Superdart equipment could be used as a measurement instrument for evaluating the performance of weapons, ammunition, and equipment.

Moving Target Training Materials. In support of the ARM POI, Simulated Moving Dry Fire Target Panels and the Dry Fire Moving Target Engagement Trainer (DRY MOVER) were developed. These training materials were locally fabricated by the Training and Audiovisual Support Center at Fort Benning, Georgia (Evans & Schendel, 1982).

Two sets of Simulated Moving Dry Fire Target Panels were designed to familiarize soldiers with the correct sight pictures associated with three lead rules for laterally moving targets.⁵ One set of panels was used for dry firing from the prone unsupported firing position, while a second set was used for dry firing from the foxhole firing position. Each target panel consisted of a 2-foot by 8-foot plywood board subdivided into four 2-foot by 2-foot sections. Each section was utilized by one soldier at a time, allowing four soldiers to train simultaneously at one panel. Six simulated moving silhouettes were designed to appear as though they were either walking, jogging, or running. Further, the silhouettes were scaled to appear as though

⁵ Previous doctrine outlined four different points of aim for laterally moving personnel targets (FM 23-9). Determining which of these four lead rules to use required the soldier to estimate both the range and speed of the target. In the revised ARM POI, the four previous lead rules were initially replaced with a simplified set of three lead rules that required the soldier to estimate only target speed. Subsequently, it was determined that the set of three lead rules could be replaced with a single lead rule appropriate for all target speeds, angles of movement, and ranges out to 200 meters (see page 11). Simulated Moving Dry Fire Target Panels are being redesigned to conform to the single-lead-rule concept.

they were at a distance of either 75, 125, or 185 meters when viewed at a distance of two meters. Three of the six silhouettes were placed on both the upper and lower halves of each section of one target panel set, while the other three silhouettes were similarly placed on the other set of target panels. These six silhouette targets, drawn to actual size, are contained in Appendix O. Soldiers dry fired at the three silhouettes on the lower half of a section, while the upper half was covered with a canvas sheet. After dry firing, soldiers walked two meters to the panel and lifted the canvas cover, exposing the upper half of the section. A scaled representation of the rifle sights was superimposed over each silhouette, illustrating the correct sight pictures associated with three different lead rules for laterally moving personnel targets. Soldiers were then able to compare the sight pictures they had used during dry firing with the correct set of sight pictures.

The Dry Fire Moving Target Engagement Trainer (DRY MOVER) was developed to allow soldiers to practice the tasks of smoothly tracking and correctly leading a moving personnel target, prior to live firing. DRY MOVER is a portable, relatively inexpensive training device that consists of two scaled, three-dimensional targets, each situated in front of a curved shield and mounted at the end of an aluminum rod. The rod is seated on a rotating shaft that is driven by a variable speed, reversible, AC motor. The motor is mounted within an aluminum housing (see Appendix P). Fifteen soldiers can be arranged in a semi-circle (five-meter radius) around the device during training. Target exposure times can be controlled by changing the position of the targets relative to the curved shields. DRY MOVER may be configured to simulate the apparent size, speed, and duration of exposure of either the 75-meter or 125-meter IRETS moving targets. Depending on the rod's direction of rotation, targets are seen as moving from right to left (clockwise) or left to right (counterclockwise). Two DRY MOVER devices were used in ARM training, one for dry firing from the foxhole position and one for dry firing from the prone unsupported position.

Rimfire Adapters. The rimfire adapter (M261 conversion kit) was designed to allow the use of .22 caliber long rifle ammunition in the M16A1 rifle. A M261 conversion kit consists of a bolt adapter assembly, which replaces the M16A1 bolt carrier group, and a magazine adapter assembly which fits standard magazines. Osborne, Morey, and Smith (1980) compared the firing of 5.56mm service ammunition with the firing of .22 caliber long rifle ammunition utilizing the rimfire adapter. Regardless of the rifle/rimfire adapter combinations tested or the manner in which test weapons were secured, the mean shot group size with rimfire adapters was found to be considerably larger than with standard military ammunition. In fact, most of the weapons tested would have had difficulty placing a three-round shot group within a 4-centimeter circle, the criterion used in current zeroing procedures. One drawback of using rimfire adapters in marksmanship training, in addition to reduced accuracy, is that a rifle must be zeroed with .22 caliber ammunition after the kit is installed, and it must be rezeroed with 5.56mm ammunition following removal. Methods for improving the effectiveness of rimfire adapters as an adjunct to rifle marksmanship training are currently being explored.

Review of Training Materials. A comprehensive review of all currently available rifle marksmanship training materials was performed (Osborne, Evans, Lucker, & Williams, 1982). This review included all known graphic training

aids, training devices, audiovisual materials, and Training Extension Course (TEC) lessons. Many of these materials were found to be either outdated, difficult to use, or contrary to current rifle marksmanship training procedures. As a guide for rifle marksmanship trainers, training materials were rated along a 3-point scale according to their degree of usefulness in current rifle marksmanship programs (Osborne, Evans, Lucke, & Williams, 1982).

Instructor Training

Prior to the implementation of any training program, instructors must have acquired the knowledge and critical skills necessary to perform as effective trainers. Before the implementation and evaluation of the BRM POI at Fort Benning, 45 instructors were given specialized training in the BRM procedures they were later to use. This training was provided during a series of three two-day sessions, with each session attended by approximately 15 instructors. The first day was devoted to classroom instruction, together with the acquisition and/or practice of marksmanship fundamentals using Weaponeer. Instruction during the second day was entirely performance-oriented, involving familiarization with BRM dry fire training, zeroing, scaled silhouette firing, and down-range feedback procedures. The second day of instruction was conducted on actual BRM ranges and live-fire training was included. Portions of the Basic Rifle Marksmanship Trainer's Guide (U.S. Army Infantry School, 1982) were provided in draft form to instructors as a written reference on BRM training procedures. Similar instructor training programs were conducted prior to the implementation of the BRM POI at other ATCs.

Two reference guides were developed to provide training guidance to rifle marksmanship instructors. In addition to providing extensive consultation to the U.S. Army Infantry School during the development of change 3 to FM 23-9, the Basic Rifle Marksmanship Trainer's Guide was prepared, evaluated, refined, and then fielded throughout the Army (U.S. Army Infantry School, 1982). While serving as an introduction to the revised BRM POI, this Guide was designed to assist BRM trainers in acquiring the knowledge and skills necessary to be a more effective instructor of basic shooting skills. However, it can also be a useful source of information for all units having personnel equipped with M16A1 rifles. All aspects of the revised BRM program are discussed, while detailed explanation concerning the major changes found in current training procedures is also presented. A more comprehensive reference, the Unit Rifle Marksmanship Training Guide (Osborne, Evans, Lucke, & Williams, 1982), contains separate sections on a variety of marksmanship training activities that can be implemented by a unit as their schedule permits. Discussed in greater detail in an earlier section of this report, this guide is devoted to both basic and advanced marksmanship skills, as well as collective training within units (see pages 14-15).

Instructor training efforts have also been directed in a variety of other areas, in an attempt to better standardize rifle marksmanship instruction throughout the U.S. Army training community. Through the USAIS, training materials and consultation have been provided to training development representatives of the Basic Non-Commissioned Officer Course (BNCOC), the Advanced

Non-Commissioned Officer Course (ANCO), the U.S. Military Academy (USMA), and the Reserve Officer Training Corps (ROTC). In addition, training materials and extensive consultation were provided to the U.S. Army Training and Doctrine Command (TRADOC) in the development of a revised BRM section to the Drill Sergeant School POI. In particular, this program addresses the coaching role of the Drill Sergeant during BRM. Finally, a one-week Infantry Officer Basic Course (IOBC) rifle marksmanship program was observed and evaluated for the technical accuracy of its content. Although this program paralleled the BRM POI to a large degree, recommendations for minor modifications to the program were made, the majority of which were subsequently implemented.

CONSTRAINTS IN PROGRAM IMPLEMENTATION

The development and implementation efforts described in this report have been largely pursued with existing training resources in the overall education system of the U.S. Army. In a training environment with unlimited resources, it is certainly expected that rifle marksmanship instruction would be improved to an even greater extent than has been demonstrated. During the process of implementing basic, advanced, and unit rifle marksmanship training programs, a number of constraints have served to limit the potential effectiveness of these programs. In particular, it is believed that the following seven factors will continue to limit the potential effectiveness of rifle marksmanship training if they remain unresolved:

1. The quality, quantity, and delay of performance feedback provided to soldiers continues to be less than optimal. Despite the introduction of 25-meter scaled targets and down-range feedback training, improvement is still needed in this area.
2. Current supplies of training ammunition are limited. While it is believed that existing levels of ammunition expenditure are adequate for most training purposes, reductions in these levels are likely to decrease the effectiveness of rifle marksmanship programs. Nevertheless, training procedures should attempt to maximize the amount of learning which can be obtained through the firing of each round.
3. Unlike the U.S. Air Force and the U.S. Marine Corps, the U.S. Army has no institutional program for the development of small arms instructors. While the Basic Rifle Marksmanship Trainer's Guide and the Unit Rifle Marksmanship Training Guide were developed to enhance the quality of marksmanship instructors, written training materials cannot be equated with a comprehensive educational system for developing professional trainers.
4. Personnel shortages and a rapid turnover of instructors are a detriment to effective rifle marksmanship training. For example, the ARM POI had to be temporarily discontinued for a period of several months because of an instructor personnel shortage. Due to the routine turnover of personnel through reassignment and separation, the need for instructor training is continuous.

5. There are a limited number of people within the U.S. Army having the requisite expertise to provide professional guidance concerning all phases of M16A1 rifle marksmanship training. The revision of BRM, ARM, and unit rifle marksmanship training procedures has highlighted the need for more of these individuals. A vast number of manhours are annually expended in providing consultation to and fulfilling the requests of ATCs and Army units worldwide. If recent advances in rifle marksmanship training are to be sustained, qualified personnel must be available to provide this necessary assistance.

6. The amount of time available to conduct rifle marksmanship training is limited, especially at the unit level. Although it is recognized that units tend to have more annual training requirements than can be successfully accomplished within a year, marksmanship training should not be limited to a matter of zeroing and qualification only.

7. Many soldiers have difficulty in zeroing their weapons. Due to the fact that no current means are available to mechanically zero an M16A1 rifle prior to firing, the initial emphasis of training is often placed on zeroing, rather than upon learning how to shoot. An M16A1 rifle is considered to be zeroed when a soldier can fire six consecutive rounds (two 3-round shot groups) into a four-centimeter circle at 25 meters. The marksmanship ability needed to perform this task is essentially equivalent to the ability to hit a 300-meter record fire target six times in a row, given the conditions of no wind and an unlimited exposure time. It is clear that the current zeroing criterion is a difficult one for the inexperienced shooter to achieve.

AREAS OF FUTURE STUDY

In an attempt to overcome many of the constraints that were just described, research in the following four areas has either been planned or recently initiated: evaluation of equipment designed to enhance the feedback given to soldiers concerning the location of misses and hits (LOMAH), low-cost simulation, videotaped instructor training, and bore sighting devices for the M16A1 rifle. In addition, research in a fifth area, performance sustainment, is needed.

LOMAH Equipment

LOMAH equipment will make it feasible to initiate systematic research on weapons training that has previously been difficult, impractical, or impossible to conduct. Examples include research in the areas of automatic fire, night fire, firing with the protective mask, and moving target engagement. Further, the improved performance feedback that could be provided to soldiers via LOMAH equipment has the potential to significantly increase the effectiveness of current rifle marksmanship training programs. A research plan for evaluating the training effectiveness of LOMAH equipment has recently been developed for the USAIS. In particular, this research plan is designed to investigate the effects of enhanced feedback on BRM performance, moving target engagement training, and night fire training.

Low-cost Simulation

Given the constraints of limited time, ammunition, instructors and facilities in current marksmanship programs, the low-cost simulation of M16A1 rifle marksmanship tasks may have the potential to be used as an effective adjunct to existing training. The Multipurpose Arcade Combat Simulator (MACS) is a relatively inexpensive training/simulation system being developed at the ARI Fort Benning Field Unit (Schroeder, 1982). Its lower cost in relation to other weapon simulators rests with its incorporation of less expensive technology. In the current prototype configuration of MACS, hardware features include a microcomputer, two disk drives, a video monitor, and a light pen modified with corrective lenses and attached to a dummy M16A1 rifle with an electronic trigger switch. Trainees aim and fire at targets presented on the monitor. The light pen determines where the weapon was aimed, and communicates this shot location information to the microcomputer. The microcomputer then provides precise and immediate feedback regarding the location of hits and misses to the trainee. Software has been developed for both the M16A1 rifle and Viper weapon systems. Major design features of current MACS software include automatic zeroing, realistic targets and backgrounds, an exercise incorporating the effects of wind and gravity in firing at stationary targets, auditory and visual feedback related to the location of hits and misses, moving target exercises, and programs to diagnose errors in marksmanship fundamentals. Future MACS development efforts will include the establishment of a recommended hardware configuration, the improvement and extension of existing software, an analysis of the applicability of the MACS concept to other weapon systems, and an evaluation of the effectiveness of MACS in rifle marksmanship training. The potential of MACS to provide voluntary opportunities for practicing marksmanship skills in an entertaining and compelling manner will also be explored.

Videotaped Instructor Training

Work has recently begun on the development of videotapes for rifle marksmanship instructor training. These videotapes will focus on the demonstration of coaching techniques for instructing soldiers in the fundamentals of basic rifle marksmanship. Together with the Basic Rifle Marksmanship Trainer's Guide and the Unit Rifle Marksmanship Training Guide, these videotapes could be used as an exportable training package for marksmanship instructors at ATCs and in Army units worldwide.

Bore Sighting Devices

Bore sighting devices provide a means of mechanically aligning a weapon's sighting system with its bore. Although their use within the U.S. Army is primarily limited to tank guns and other large caliber weapons, they have reportedly saved considerable amounts of time and ammunition, because fewer rounds have to be fired during the zeroing process. Four different bore sighting devices were informally evaluated to determine their suitability for use with the M16A1 rifle. In general, it was found that these devices, in

their current configuration, could facilitate the zeroing process for those rifles with sights grossly out of zero. For the majority of M16A1 rifles, however, a more precise device designed specifically for the M16A1 rifle is needed. In view of the difficulty many soldiers experience in zeroing their rifles, further research in this direction is recommended. It is believed that a bore sighting device could be designed for the M16A1 rifle which would enable a near final zero to be mechanically obtained in the majority of cases.

Performance Sustainment Research

Research is needed in the area of rifle marksmanship performance sustainment, particularly since the amount and types of training necessary for the development and long-term retention of marksmanship skills are not known. Despite the inherent difficulties associated with conducting research of this type (Thompson, Morey, Smith, & Osborne, 1981), the information it could provide might enable better decisions to be made regarding such matters as the establishment of appropriate performance standards and the optimal scheduling of unit rifle marksmanship training activities.

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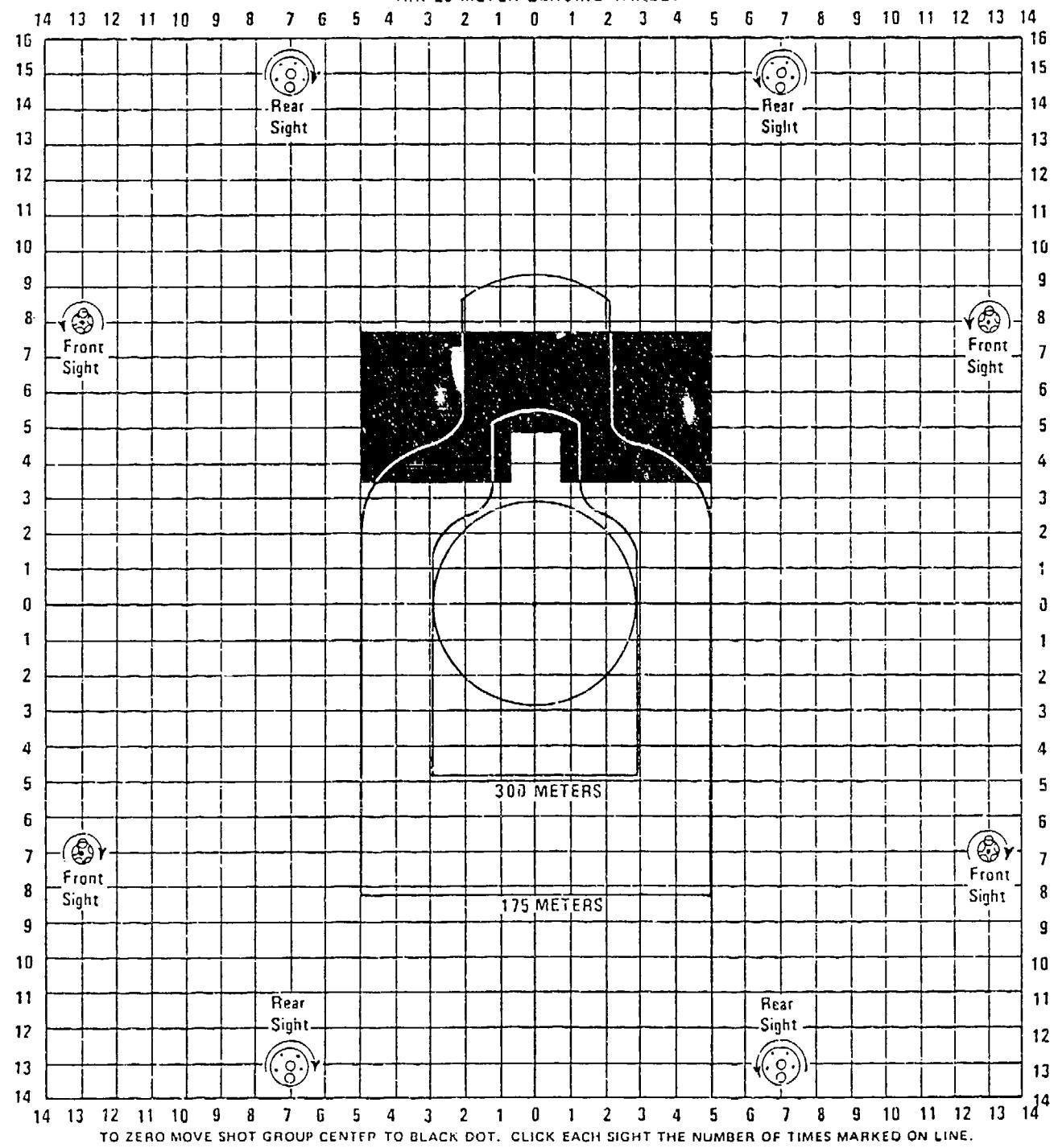
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APPENDIX A

ARMY RESEARCH INSTITUTE⁶
25-METER ZEROING TARGET

⁶This is a zeroing target which was used in early ARI marksmanship research and is not recommended for current use.

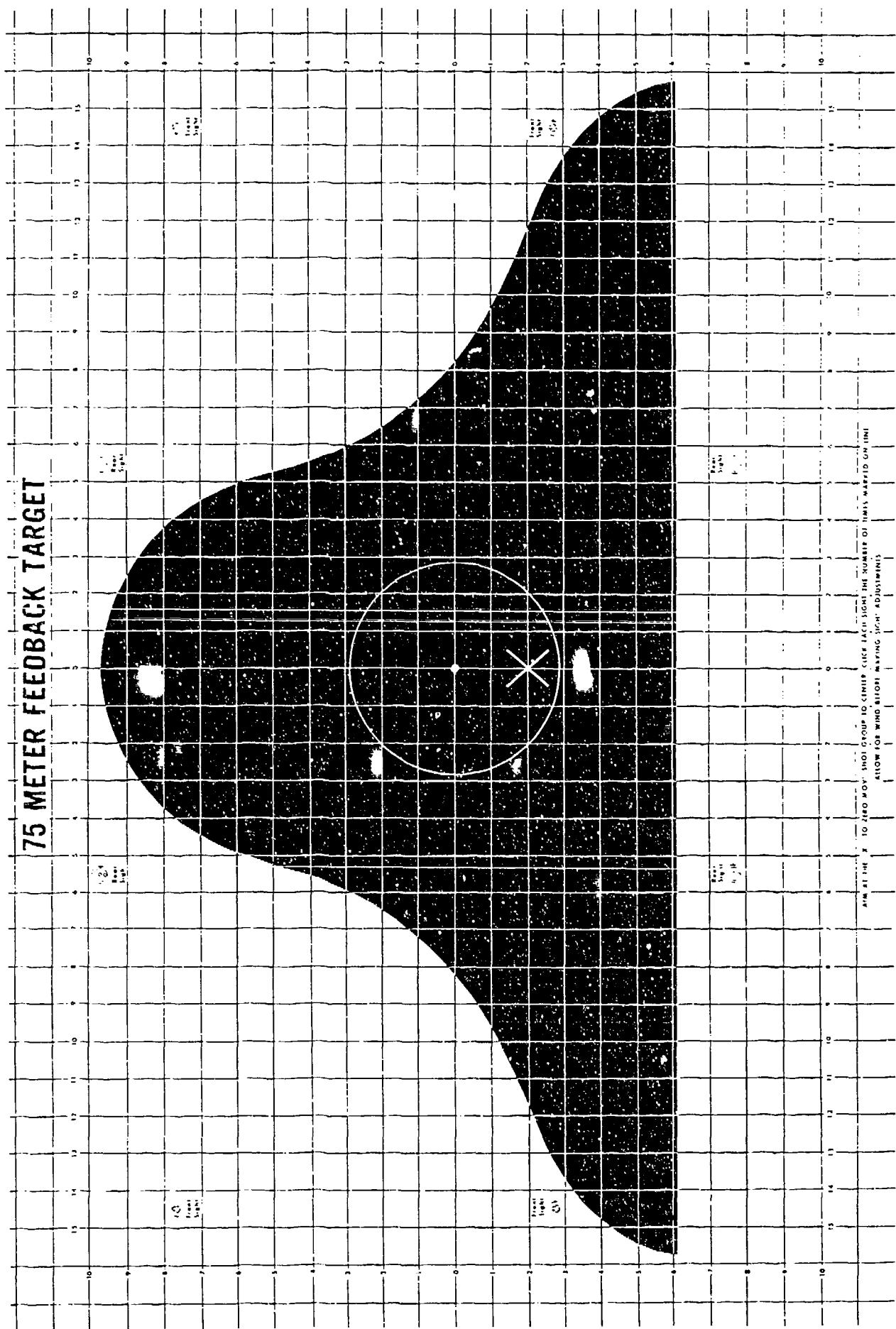
ARI 25 METER ZEROING TARGET



APPENDIX B
75-METER DOWN-RANGE FEEDBACK TARGET⁷

⁷This is a reduced copy of the current 75-meter down-range feedback target used in BRM at ATCs lacking access to KD range facilities. It is also available for units.

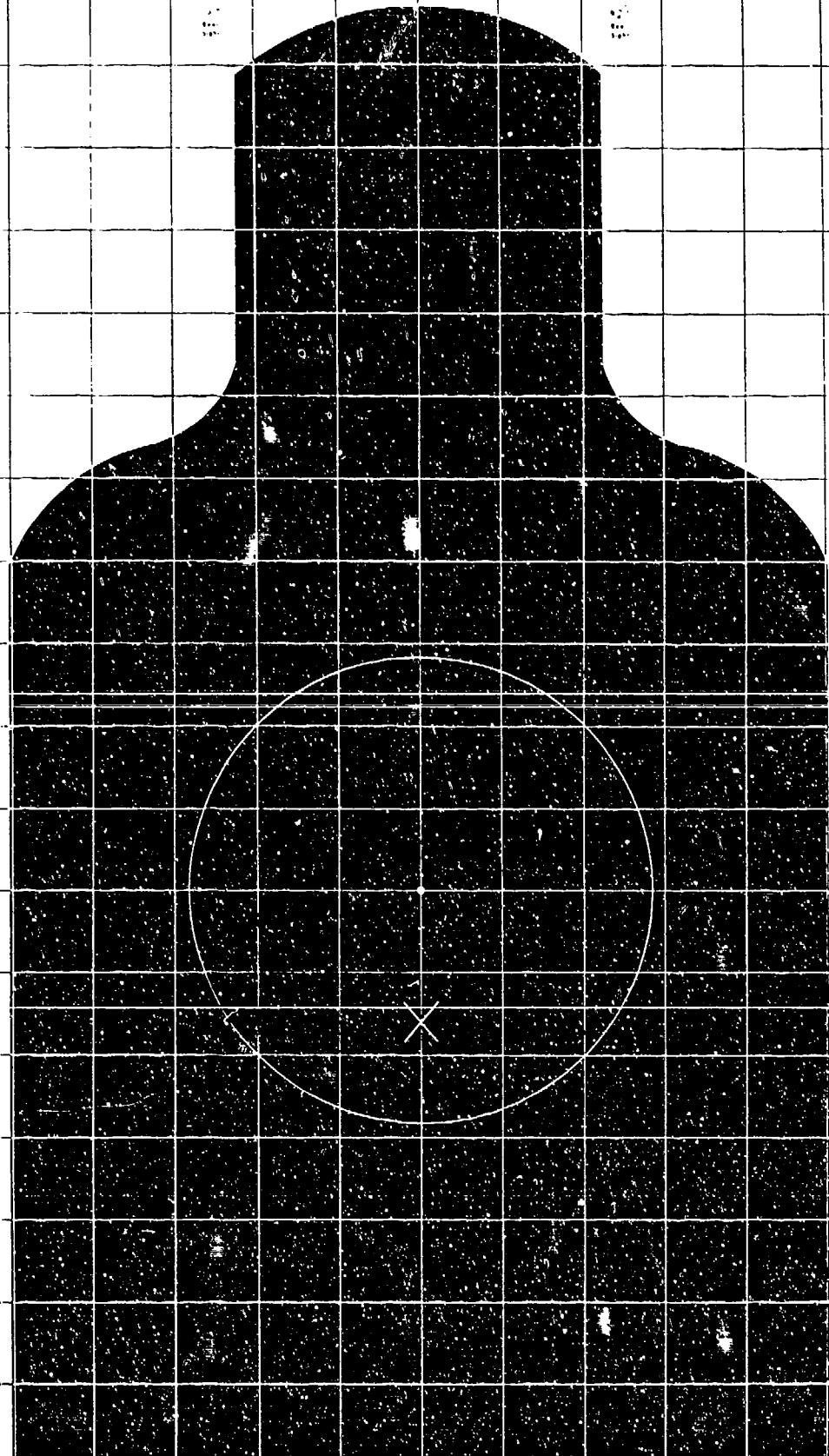
75 METER FEEDBACK TARGET



APPENDIX C
175-METER DOWN-RANGE FEEDBACK TARGET⁸

⁸This is a reduced copy of the current 75-meter down-range feedback target used in BRM at ATCs lacking access to KD range facilities. It is also available for units.

175 METER FEEDBACK TARGET



175 METER FEEDBACK TARGET
AIM AT THE S TO ZERO MOVE SHOT GROUP TO CENTER. TAKE EACH SHOT THE NUMBER OF TIMES MARKED ON LINE
ADJ. FOR WIND BEFORE MAKING SIGHT ADJUSTMENTS

APPENDIX D

25-METER SLOW FIRE SCALED SILHOUETTE TARGET⁹
FOR M16A1 RIFLE WITH STANDARD SIGHTS

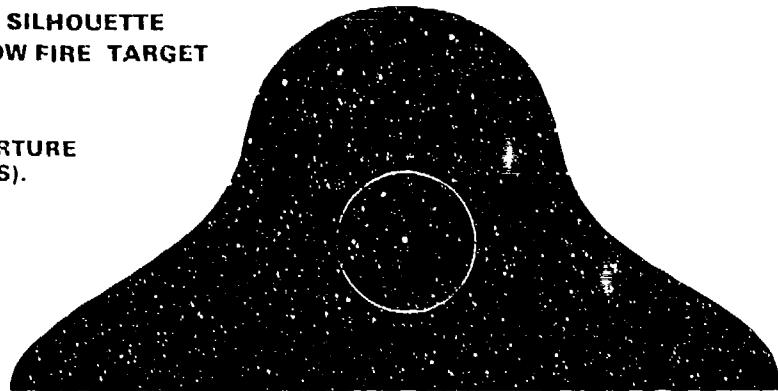
⁹This is a reduced copy of the 25-meter slow fire scaled silhouette target used in BRM. It is also available for units. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with standard sights.

25 METER SCALED
SILHOUETTE
SLOW FIRE TARGET

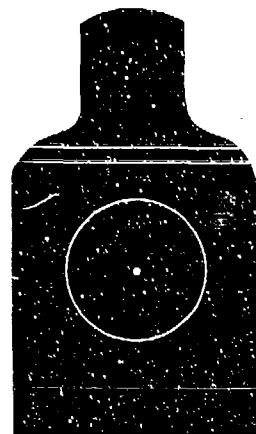
(FIRED WITH "L" APERTURE
ON STANDARD SIGHTS).



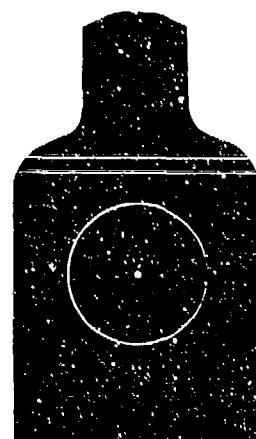
300 M



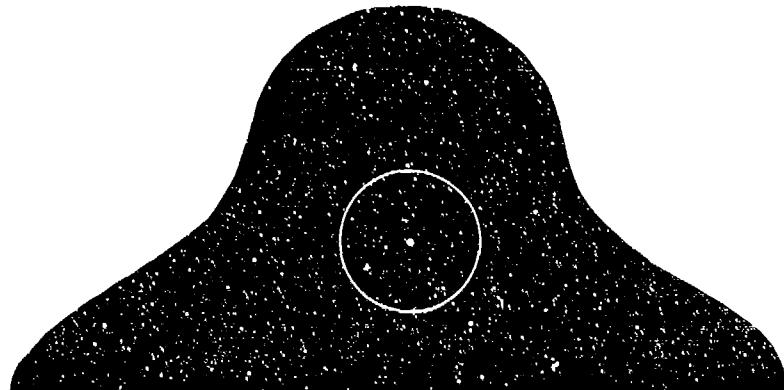
75 M



175 M



175 M



75 M

USE LONG RANGE SIGHT



300 M

APPENDIX E

25-METER TIMED FIRE SCALED SILHOUETTE TARGET¹⁰
FOR M16A1 RIFLE WITH STANDARD SIGHTS

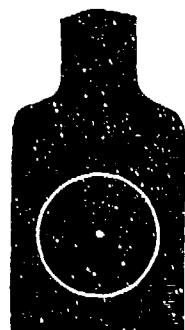
¹⁰This is a reduced copy of the 25-meter timed fire scaled silhouette target used in BRM and ARM. It is also available for units. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with standard sights.

25 METER SCALED
SILHOUETTE
TIMED FIRE TARGET

(FIRED WITH "L" APERTURE
WITH STANDARD SIGHTS)



300 M



200 M



250 M



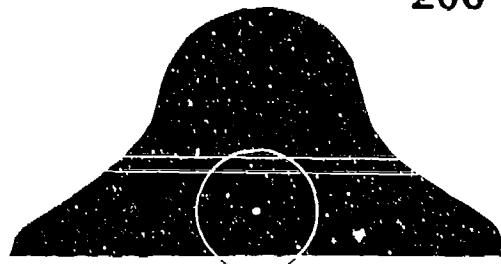
200 M



250 M



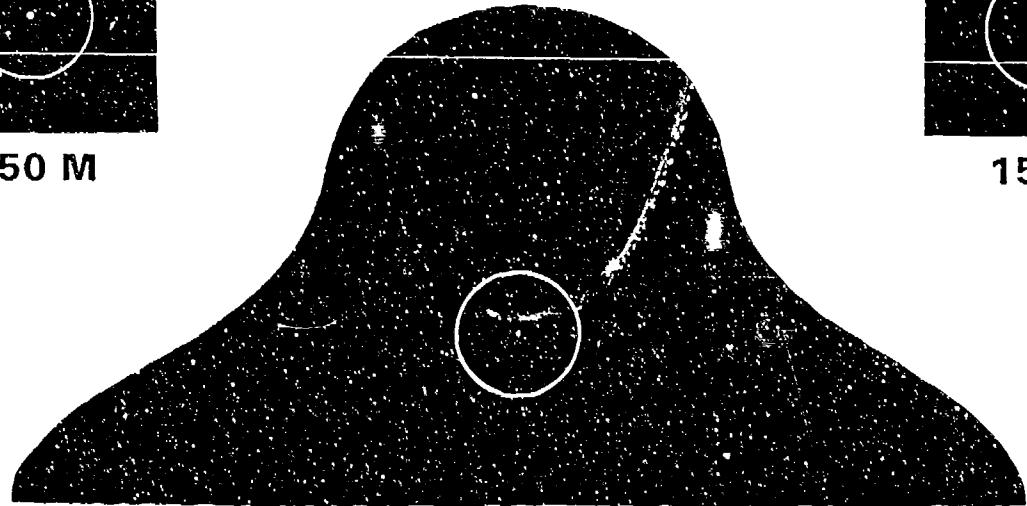
150 M



100 M



150 M



50 M

THE WHITE DOT ON EACH TARGET SHOWS THE BEST AIMING POINT FOR TARGETS AT ACTUAL DISTANCE. IF AN ADJUSTED AIMING POINT IS USED AT 25 METERS, BULLETS SHOULD HIT WITHIN THE CIRCLE, BUT ARE SCORED AS HITS IF THEY HIT ANYWHERE IN THE SILHOUETTE

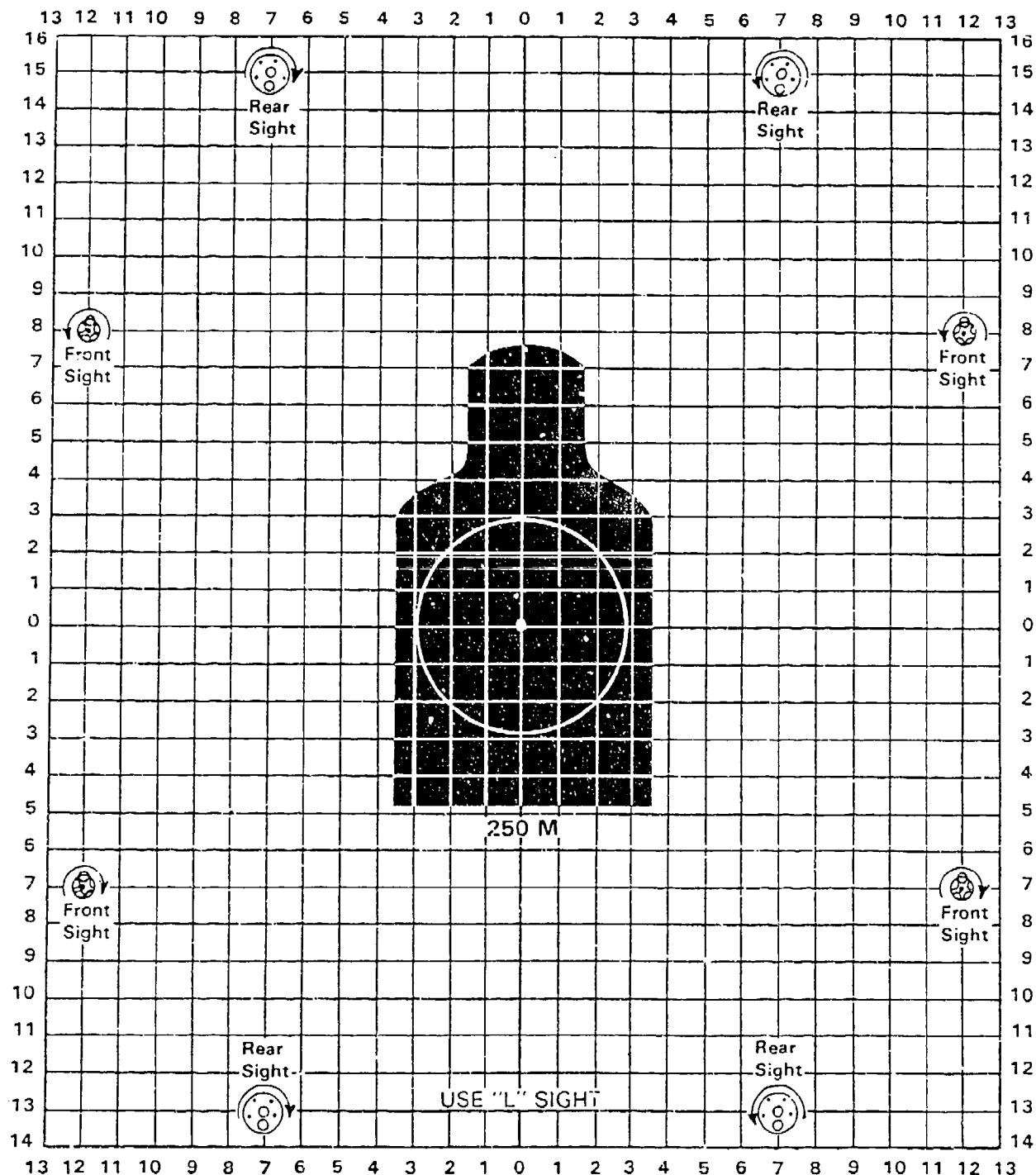
USE LONG RANGE SIGHT

APPENDIX F

STANDARD 25-METER ZEROING TARGET FOR M16A1 RIFLE
¹¹
(WITH STANDARD SIGHTS)

¹¹This is the standard 25-meter zeroing target used in BRM. It is also available for units. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with standard sights.

25 METER ZEROING TARGET FOR M16A1 RIFLE
(WITH STANDARD SIGHTS)



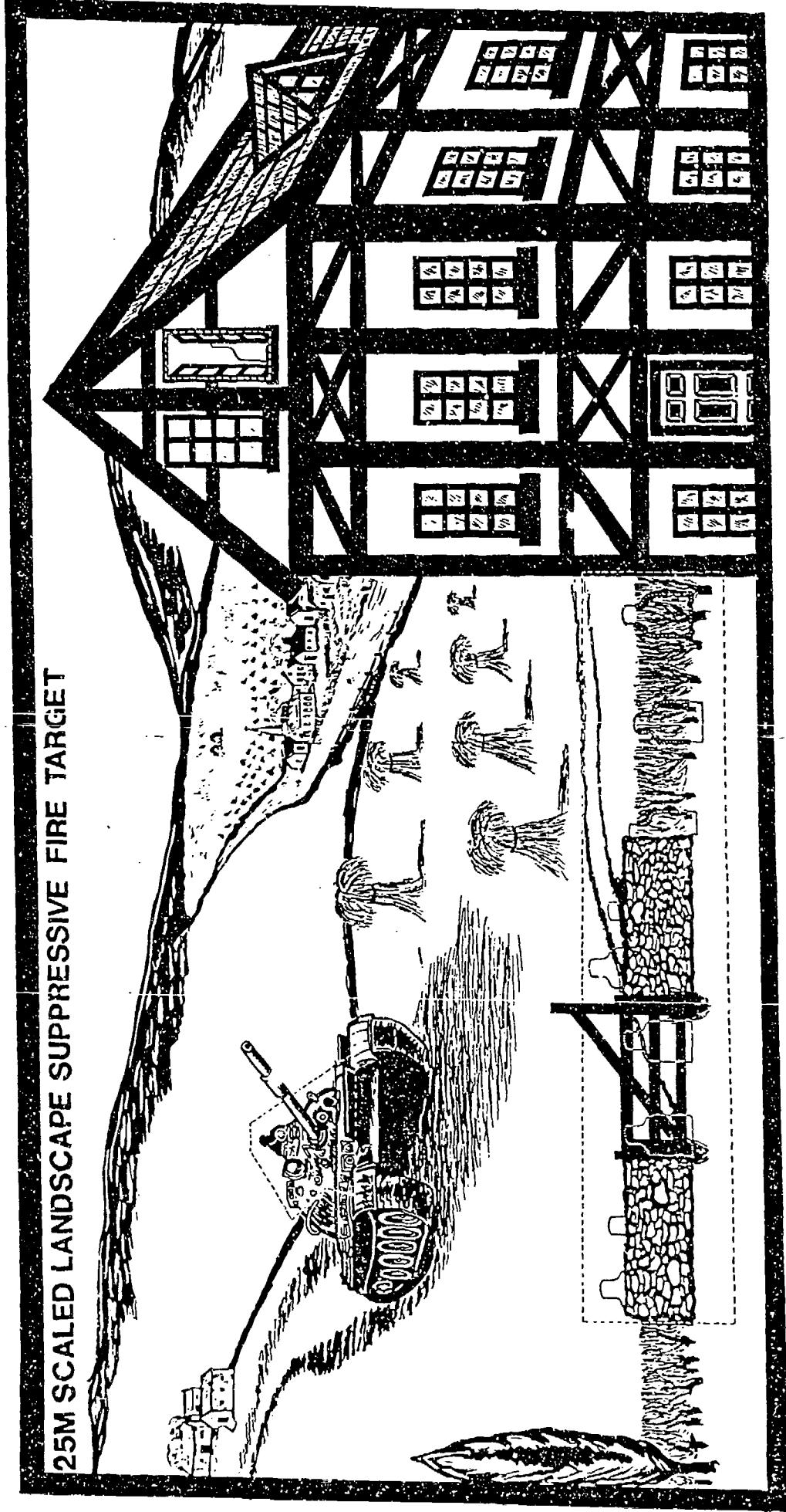
1. AIM AT TARGET CENTER. ADJUST SIGHTS TO MOVE SHOT GROUP CENTER AS CLOSE AS POSSIBLE TO WHITE DOT.

2. AT COMPLETION OF ZERO, ROTATE REAR SIGHT TO UNMARKED APERTURE AND WEAPON WILL BE BATTLESIGHT ZERO FOR 250 M.

P9467

APPENDIX G
25-METER SCALED LANDSCAPE SUPPRESSIVE FIRE TARGET¹²

¹²This is a reduced copy of the 25-meter scaled landscape suppressive fire target used in ARM. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with standard sights.



APPENDIX H
25-METER SCALED SIMULATED MOVING TARGET¹³

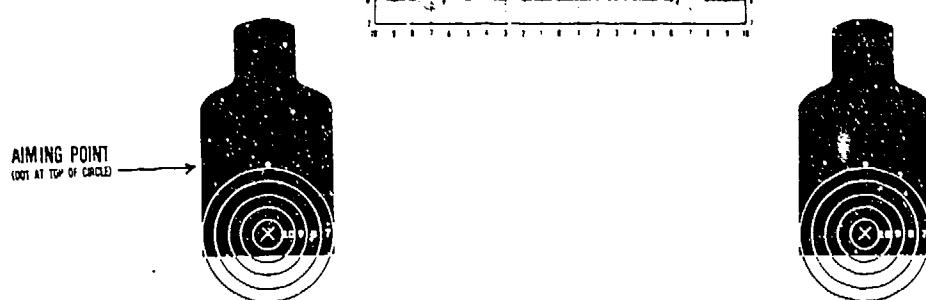
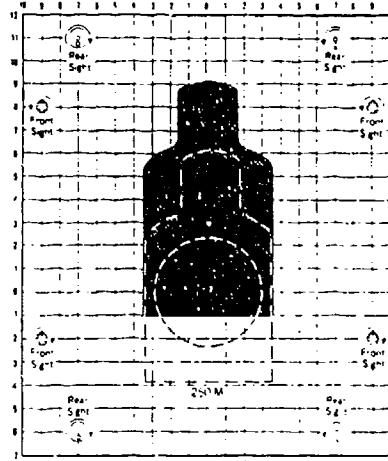
¹³This is a reduced copy of the 25-meter scaled simulated moving target used in ARM. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with standard sights.



APPENDIX I
FORSCOM 25-METER COMPETITIVE RIFLE TARGET¹⁴

¹⁴This is a reduced copy of the 25-meter competitive rifle target used in the FORSCOM Commander's Company Level Marksmanship Competition (FORSCOM Circular C-10, 1 Jan 81). The target is designed to be fired using either the unmarked rear aperture on M16A1 rifles equipped with standard sights or the rear aperture marked "L" on M16A1 rifles equipped with the LLLSS.

25M SCALED (250M) COMPETITIVE RIFLE TARGET



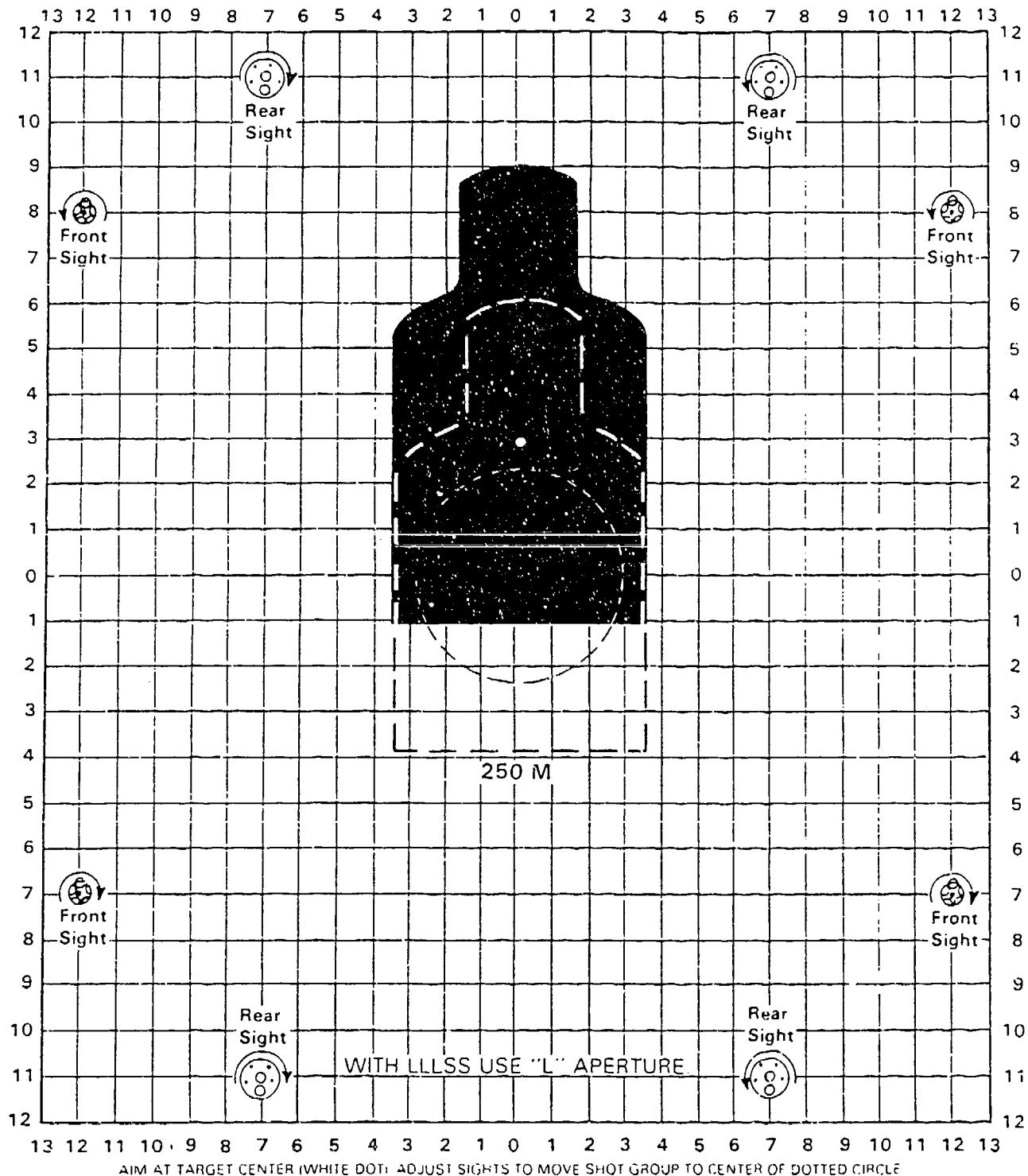
NAME _____
UNIT _____
SCORE _____

APPENDIX J

STANDARD 25-METER ZEROING TARGET FOR M16A1¹⁵ RIFLE (WITH LOW LIGHT LEVEL SIGHT SYSTEM)

¹⁵This is the standard zeroing target used with M16A1 rifles equipped with the LLLSS. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with the LLLSS, although it can also be fired using the unmarked rear aperture on M16A1 rifles with standard sights.

25 METER ZEROING TARGET FOR M16A1 RIFLE
WITH LOW LEVEL LIGHT SIGHT SYSTEM (LLLSS)



AIM AT TARGET CENTER (WHITE DOT) ADJUST SIGHTS TO MOVE SHOT GROUP TO CENTER OF DOTTED CIRCLE

88348 Army-Ft. Benning, Ga. 1980

APPENDIX K

25-METER SLOW FIRE SCALED SILHOUETTE TARGET
FOR M16A1 RIFLE WITH LOW LIGHT LEVEL SIGHT SYSTEM¹⁶

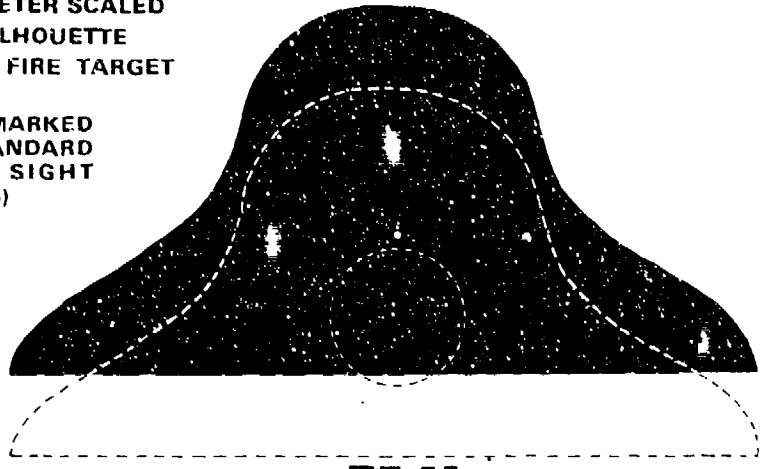
¹⁶This is a reduced copy of the 25-meter slow fire scaled silhouette target available for units having rifles equipped with the LLLSS. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with the LLLSS, although it can also be fired using the unmarked rear aperture on M16A1 rifles with standard sights.

25 METER SCALED
SILHOUETTE
SLOW FIRE TARGET

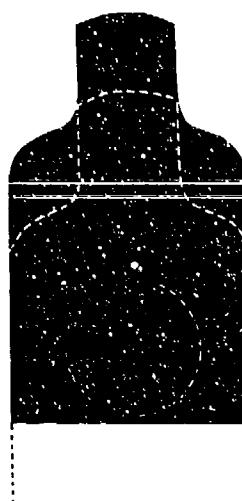
(FIRED USING UNMARKED
APERTURE ON STANDARD
SIGHTS OR "1" SIGHT
APERTURE ON LLLSS)



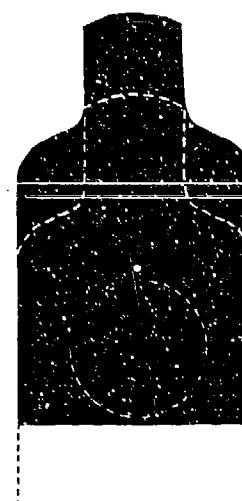
300 M



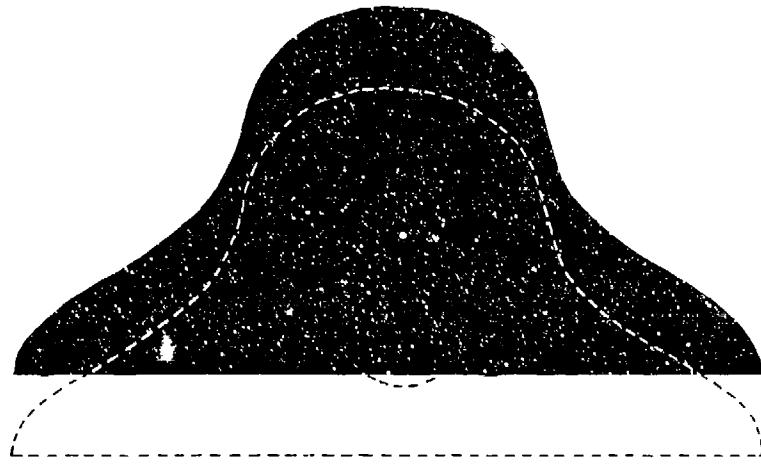
75 M



175 M



175 M



75 M

88348 Army-Ft. Benning, Ga. 1980



300 M

APPENDIX L

25-METER TIMED FIRE SCALED SILHOUETTE TARGET¹⁷ FOR M16A1 RIFLE WITH LOW LIGHT LEVEL SIGHT SYSTEM¹⁷

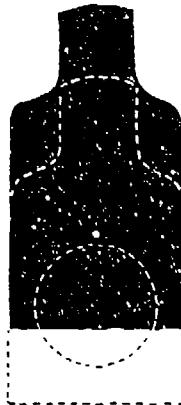
¹⁷This is a reduced copy of the 25-meter timed fire scaled silhouette target available for units having rifles equipped with the LLLSS. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with the LLLSS, although it can also be fired using the unmarked rear aperture on M16A1 rifles with standard sights.

25 METER SCALED
SILHOUETTE
TIMED FIRE TARGET

(FIRED USING UNMARKED
APERTURE ON STANDARD
SIGHTS OR "L" SIGHT
APERTURE ON LLLSS)



300 M



200 M



200 M



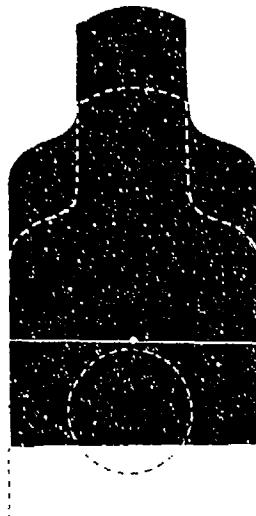
300 M



250 M



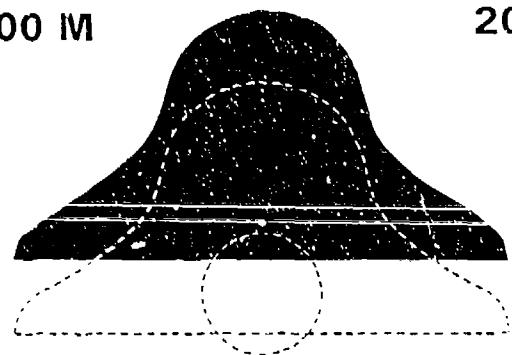
250 M



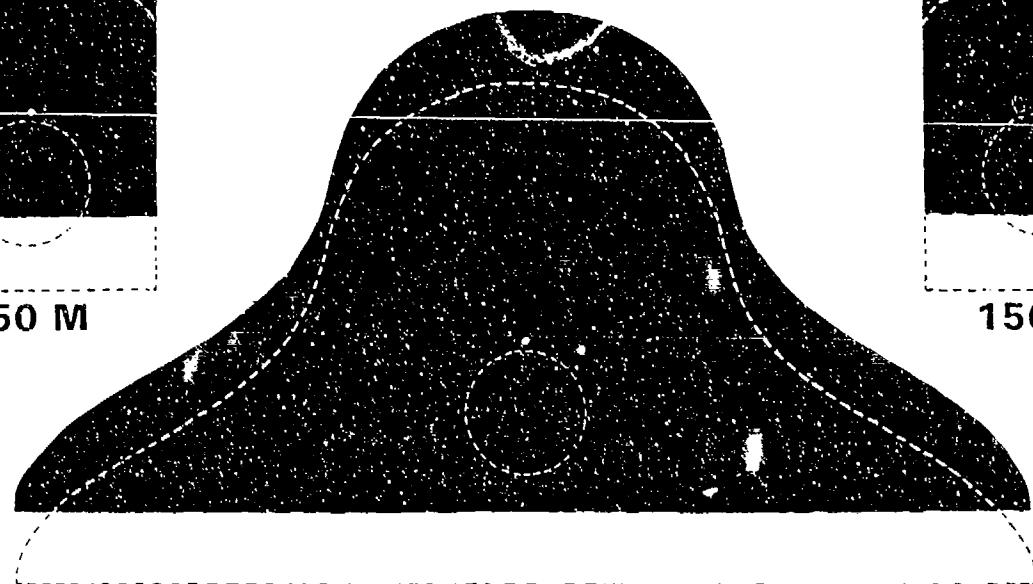
150 M



150 M



100 M



50 M

58145 Army-Ft. Benning, Ga. 1960

THE WHITE DOT ON EACH TARGET SHOWS THE BEST AIMING POINT FOR
TARGETS AT ACTUAL DISTANCE IF AN ADJUSTED AIMING POINT IS USED AT 25
METERS. BULLETS SHOULD HIT WITHIN THE CIRCLES BUT ARE SCORED AS HITS
IF THEY HIT ANY PART OF THE DOTTED SILHOUETTE

APPENDIX M
25-METER ALTERNATE COURSE "C" TARGET¹⁸

¹⁸This is a reduced copy of the 25-meter alternate course "C" target available for units conducting record fire qualification without having access to a record fire or KB range. The target is designed to be fired using the rear aperture marked "L" on M16A1 rifles equipped with standard sights.

25 METERS
ALTERNATE COURSE "C"
RECORD FIRE QUALIFICATION



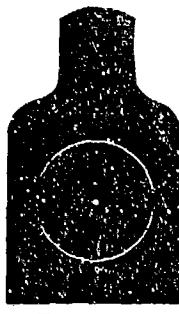
25 M



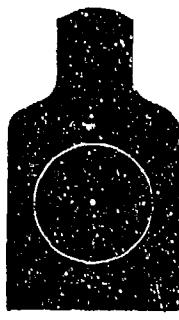
300 M



150 M



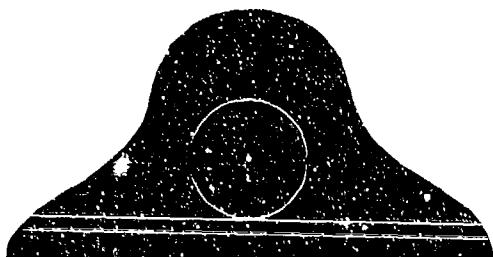
200 M



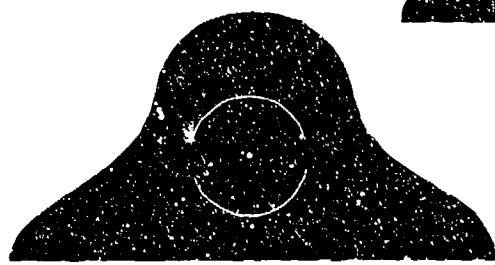
200 M



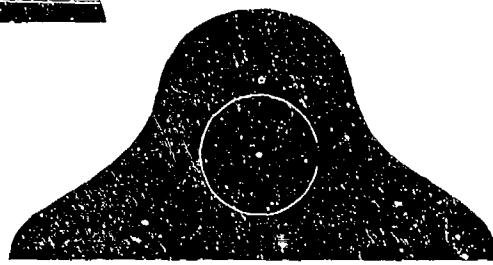
150 M



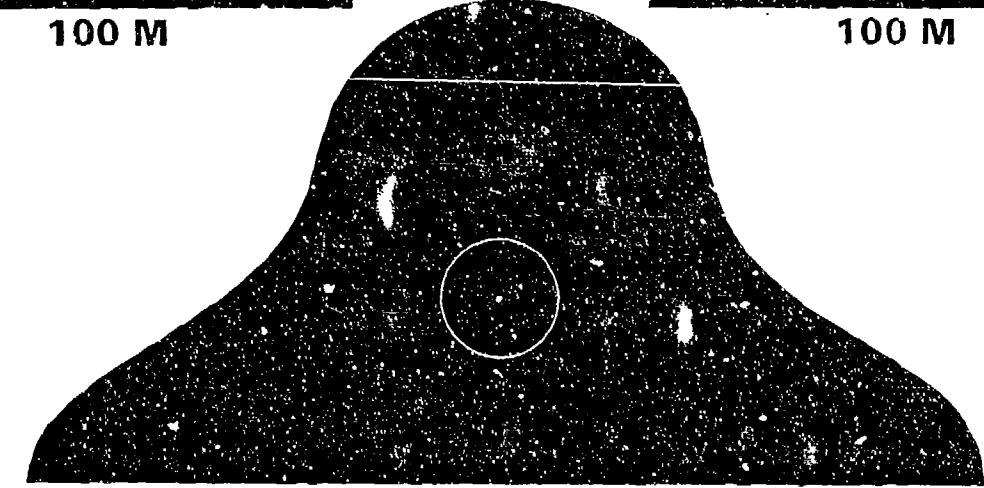
100 M



100 M



100 M



50 M

ARMY Ft. Benning, Ga. 1980

THE WHITE DOT ON EACH TARGET SHOWS THE CENTER OF MASS AIMING POINT
BULLETS SHOULD HIT WITHIN THE CIRCLE, BUT ARE SCORED AS HITS IF THEY HIT ANY
PART OF THE SILHOUETTE

APPENDIX N

15-METER ALTERNATE COURSE "C" TARGET¹⁹

¹⁹This is a reduced copy of the 15-meter alternate course "C" target available for units conducting record fire qualification without having access to a record fire, KD, or 25-meter range.

15 METERS
ALTERNATE COURSE "C"
RECORD FIRE QUALIFICATION



250 M



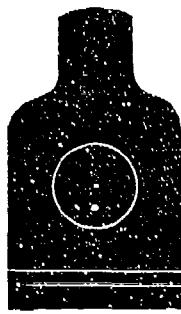
300 M



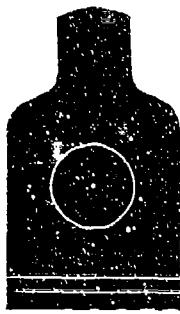
200 M



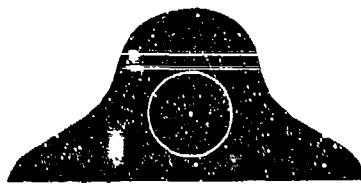
200 M



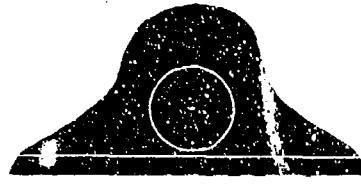
150 M



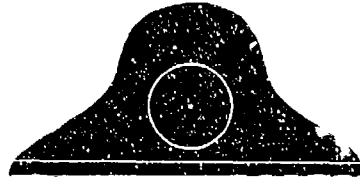
150 M



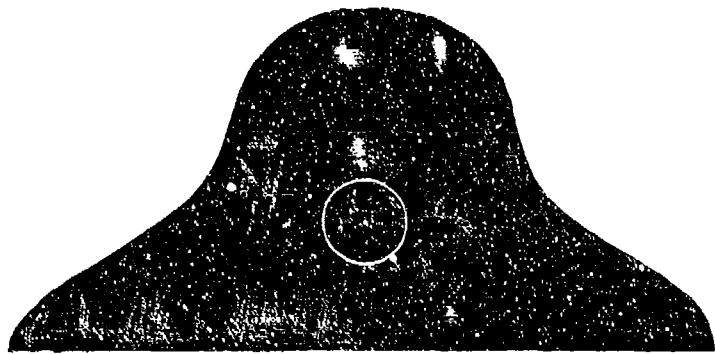
100 M



100 M



100 M



50 M

48114 Army-Ft. Benning, Ga. 1980

THE WHITE DOT ON EACH TARGET SHOWS THE CENTER OF MASS AIMING POINT
BULLETS SHOULD HIT WITHIN THE CIRCLE, BUT ARE SCORED AS HITS IF THEY HIT ANY
PART OF THE SILHOUETTE.

APPENDIX O

TWO-METER SCALED SILHOUETTES
USED IN SIMULATED MOVING DRY FIRE TARGET PANELS²⁰

²⁰

These are the two-meter scaled silhouettes placed on the simulated moving dry fire target panels used in ARM.



APPENDIX P

DRY FIRE MOVING TARGET ENGAGEMENT TRAINER²¹
(DRY MOVER)

²¹This is an exterior view of the dry fire moving target engagement trainer used in ARM (top). Three-dimensional targets are placed in front of each curved shield (bottom).

